MONTHLY WEATHER REVIEW,

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(General Weather Service of the United States.)

WAR DEPARTMENT,

Office of the Chief Signal Officer,

DIVISION OF

TELEGRAMS AND REPORTS FOR THE BENEFIT OF COMMERCE AND AGRICULTURE.

INTRODUCTION.

In preparing this REVIEW the following data, received up to October 14th, have been used, viz: the regular tri-daily weather charts, containing the data of simultaneous observations taken at 144 Signal Service stations and 15 Canadian stations, as telegraphed to this office; 162 monthly journals and 160 monthly means from the former, and 15 monthly means from the latter; reports from 8 Sunset stations; 203 monthly registers from Voluntary Observers; 42 monthly registers from United States Army Post Surgeons; Marine Records; International Simultaneous Observations; monthly reports from Voluntary Observers in, and the local Weather Service of, Missouri; reliable newspaper extracts; special reports.

BAROMETRIC PRESSURE.

The general distribution of barometric pressure as exhibited on Chart No. II differs slightly from the mean pressure as determined from the observations for many years. The greatest variation from the mean occurs on the North Pacific coast, where the pressure is seven hundredths above the normal at Portland. The pressure has increased from three to six hundreths in all of the districts east of the Mississippi, and the area of mean high barometer which covered the Southern States in *September* has increased and moved north over the Middle Atlantic States and New England.

Barometric Ranges.—The barometric range for the several stations increases with the latitude and is unusually great in the Upper Mississippi valley and Upper Lake region, located near the track of the centre of the storm which passed over these regions on the 16th and 17th. The range increases on the Atlantic coast from 0.30 at Key West to 1.22 at Portland, Me., and in the Mississippi valley from 0.68 at New Orleans to 1.68 at La Crosse, this being the greatest range reported. In the Lake region the range varies from 0.89 at Rochester to 1,51 at Duluth. On the Pacific coast the range increases with the latitude but is much less than at corresponding latitudes on the Atlantic coast.

Areas of High Barometer.—Nine areas of high barometer have appeared within the limits of the Signal Service stations during the month of October, four of which—Nos. II, V, VII and IX were traced from the north Pacific to the Atlantic coast. No. VI apparently developed in the Southwest and followed the general direction of the storm of the 16th and 17th, being preceded by the most severe "norther" of the month on the Texas coast.

No. I.—This area was central near Philadelphia on the morning of the 1st and extended along the Atlantic coast from Maine to Florida, and from the Atlantic coast westward over all districts east of the Mississippi river. The general direction of the movement was to the east southeast, but the advance to the east was much retarded near the coast, the winds shifting to the east and south on the 2nd. Clear weather with slowly rising temperature prevailed in the eastern portion of the United States during the 2nd and 3rd as the area passed to the east over the Atlantic. The course of this area, previous to the 1st, has been given in the REVIEW for September, where it is described as No. VI.

No. II.—The reports from the Upper Missouri valley at midnight of the 1st indicated the advance of this area from British America and the North Pacific coast and the morning report of the 2nd showed that the entire region west of the Mississippi to the Pacific coast was within the limits of this area. The pressure increased to 30.20 on the Eastern Slope, and north to west winds and clear weather prevailed between the Mississippi river and the Rocky Mountains, except the light rains which preceded a "norther" on the Texas coast. On the morning of the 4th the centre was located near Dodge City, Kans., and a maximum velocity of wind of 33 miles from the north occurred at Indianola between the midnight and morning reports. High winds continued on the Texas coast during the 4th, the afternoon report showing a velocity of 36 miles from the north. As the centre passed to the Mississippi valley the winds shifted to northerly in the Gulf States on the 5th The "norther" although severe in western Texas did not extend east of Indianola with sufficient force to justify Cautionary Signals at Galveston, the maximum velocity at the latter station being only 20 miles north on the morning of the 4th.

No. III.—The pressure continued above the normal over the western half of the continent during the 4th, when the preceding area was apparently re-inforced by area No. III, which was central in Montana where the pressure was thirty-five hundredths above the normal. The course of this centre during the 5th and 6th was almost directly east over the Lake region, where the area was central on the morning of the 7th. Fresh and brisk northwest winds were reported at the Lake stations and generally clear weather prevailed in the districts east of the Mississippi river, except in the southern portion of the South Atlantic States, which was within the limits of low area No. IV during the 7th. The pressure increased at the centre as this area passed to the east of the coast line over New England on the 8th and the gradient increased rapidly in the southwest quadrant as the tropical storm traced as No. IV moved to the northeast.

No. V—advanced from the North Pacific on the 9th, the p. m. report of that date showing a pressure above the normal at all stations in California, and twenty-four hundreths of an inch above at Olympia. The barometer rose rapidly during the 10th at stations between the North Pacific coast and the Lake region, the centre of greatest pressure being in the Upper Missouri valley, near Fort Buford, where it was forty-five hundreths of an inch above the normal on the morning of the 11th. During the 12th and 13th this area passed slowly to the eastward over the Lake region, attended by generally clear weather and frosts as far south as North Carolina. Brisk and high northwest to northeast winds prevailed on the Middle and South Atlantic coasts on the 14th, and on the 15th the centre passed to the east of the coast line when the wind, along the coast, shifted to the southeast and south as low area No. VI., then central near Dodge City, moved to the northeast. Heavy snows were reported at the Rocky Mountain stations on the 11h, when this area was central in the extreme Northwest, and an area of cold completely inclosed by the isothermal lines of 40° and 50° was plainly marked on the tri-daily weather maps. At the p. m. report of the 11th the temperature was 81° at Fort Gibson and 39° at Dodge City, and the crowding of the isothermal lines in the Southwest indicated the approach of the "norther" which occurred in the interior of Texas. Off-shore Signals were ordered at the stations on the Texas coast, but the wind, although shifting to the north, did not reach a high velocity on the immediate coast.

No. VI.—This area moved from the Southwest, the centre of greatest pressure following the general direction of the line marked as the track of low area No. VI. The violent "norther" which occurred at Indianola and Galveston was not anticipated owing to the failure of telegraph lines in the Southwest at the two preceding reports. The pressure increased in the southern portion of the United States during the 16th, 17th and 18th as this area developed and passed slowly to the east. It moved to the east off the Atlantic coast on the 19th, with a pressure of 30.30 extending from Jacksonville to Boston.

No. VII.—The a. m. telegraphic reports of the 20th indicated the advance of an area of high barometer from the North Pacific, the pressure at Olympia having increased to twenty-one hundredths above the normal, and at the a. m. report of the following day, the centre of this area had passed east of the Rocky mountains, the departure from the normal pressure being greatest in the Upper Missouri valley, where it ranged from +0.30 to +0.48. During the 21st, the pressure increased slowly over the regions west of the Mississippi and north of the Ohio river, accompanied by colder north to west winds. The centre of greatest pressure passed almost directly south and then to the east during the 22nd and 23rd, extending over the Southern States. Frosts were reported from Cedar Keys, Fla., Savannah and Atlanta, Ga., and Montgomery, Ala., on the morning of the 24th, when this area was central near Nashville, Tenn. The pressure continued high in the South Atlantic States until the 26th, when the winds shifted to the east and south, with rising temperature in advance of low-area No. IX. Severe local storms occurred in northern Texas, when the centre of this area was west of the Mississippi river, but the "norther," for which signals were ordered, did not reach the coast with the expected force.

No. VIII—followed low-area No. IX, moving to the southeast from the Saskatchewan region to the Upper Lakes, the centre remaining north of the stations of observation until it reached the St. Lawrence valley on the 28th, when it passed over New England and apparently moved to the south-

east, disappearing rapidly as low-area No. IX, moved to the northeast from the Gulf of Mexico. The reports from the extreme Northwest and the Pacific coast, show that this area did not pass from the North Pacific region, but indicate that it originated north of the United States and east of the Rocky mountains. Telegraphic observations from the Northwest Territory and west shore of Hudson's bay, would enable this office to anticipate the sudden changes in temperature which frequently occur in the northeastern and northern portions of the United States.

No. IX.—This area passed from the North Pacific over the Rocky Mountains on the 29th and moved southward on the 30th, accompanied by cold northerly winds and a light "norther" on the Texas coast, which continued during the 31st, the wind reaching a velocity of 31 miles per hour at Indianola, when the centre of greatest pressure was near Fort Gibson. North to west winds and clear, cold weather prevailed throughout all districts east of the Mississippi as this area moved slowly to the east over the Southern States on the 31st.

Areas of Low Barometer.—On chart No. I will be found the tracks of centres of the areas of low pressure, which have been traced from the tri-daily weather maps of the month. The mean latitude of these tracks is several degrees to the north of the mean latitude of low areas for corresponding month of previous years. Nos. IV, VIII and XI, were tropical storms, which developed south of latitude 25°, and No. VI, the most marked depression of the month, apparently developed in the southwest, probably in northern Texas. No. XII is the only depression that crossed the Rocky mountains, and this disappeared before reaching the Lake region.

No. I.—This depression had partially developed in the extreme Northwest during the latter part of September and on the 1st a trough of low pressure extended from Kansas north to British America, where the lowest pressures were reported. The course was southeast during the 1st and 2nd, passing over the Upper Lake region, attended by light rains as far south as the Ohio valley and heavy rains in the western quadrant, as the winds shifted to the west and north. At midnight of the 2nd, the direction of the movement changed to the no theast and the depression took the form of an extended trough, which rapidly disappeared. Rain continued in the Lower Lake region during the 3rd, and a second area of low barometer developed during the night, which remained central near Buffalo until the morning report of the 4th, when it passed northeastward into the St. Lawrence valley. Cautionary signals were ordered for stations on the Upper Lakes and Lake Erie, and were generally justified by the high winds which followed the display. High winds also occurred on Lake Ontario after the centre had passed to the east.

No. II.—This area apparently developed north of the Lake region and although high westerly winds occurred at several stations on Lakes Michigan, Huron and Erie, the weather remained clear or fair and the temperature remained above 50° at the northern stations. As this depression moved to the east, north of the stations of observation the track of its centre could only be located approximately. Severe westerly gales were reported in the lower St. Lawrence valley after the centre had reached the Atlantic coast.

No. III.—The barometer continued below the normal in the extreme Northwest from the 6th to the 9th, the centre of lowest pressure apparently advancing and receding and moving to the south as indicated by the loop-shaped track on Chart No. I. The easterly movement commenced as soon as high area No. V appeared on the Pacific coast, on the 9th, when this depression assumed a well defined elliptical form in the Upper Mississippi valley and passed rapidly to the northeast, causing but a slight disturbance in the western districts, notwithstanding the unusually low barometer at the centre at the afternoon report of the 9th when the gradient was decided in the eastern half of the depression. Signals were ordered for stations on the Upper Lakes for the storm on the 7th, but lowered and ordered a second time on the 9th, when they were generally justified, but owing to the course of the centre, the storm was less severe than was anticipated.

No. IV.—Marine reports from the Gulf of Mexico indicate that this passed from the northern portion of Yucatan across the Gulf as a severe storm, and its course is well marked after the centre came within the limits of the signal stations. The wind increased in force along the Florida coast during the night of the 8th, and very heavy rains were reported in the southern portion of the South Atlantic States as far north as Cape Hatteras. At the afternoon report of the 8th, the centre was between Cedar Keys and Jacksonville and the gale had increased on the coast. Signals had been displayed at stations south of Norfolk, and special warnings sent to the principal cities on the Atlantic coast, informing captains and shipmasters about to proceed south of the storm on the coast. The wind reached a velocity of 52 miles at Savannah; 40 at Smithville; 37 at Charleston; 32 at Kittyhawk and 39 at Cape Henry.

No. V.—This area was central in the Upper Missouri valley on the morning of the 13th, and probably developed east of the Rocky Mountains in British America. It was first observed as a depression, central within the limits of the Signal Service stations, at midnight of the 13th near Yankton, after which it moved to the northeast over the northern portion of the Lake region. The barometer was decidedly low at the centre on the morning of the 14th, that at St. Paul reading 29.24. High winds prevailed over Lakes Michigan and Superior as the depression passed from St. Paul to the north of the Upper Lake region, the velocity at Milwaukee reaching 33 miles, SW., and at Esca-

naba, 32, S. Dangerous winds extended over Lake Huron, but the rapid movement of the storm toward Hudson's Bay decreased the gradients in the Lower Lake region. The signals ordered for this storm were continued for the succeeding storm, which had partially developed south of the Missouri valley on the 15th, with indications that it would prove dangerous to shipping in the Lake region.

No. VI.—This depression was central near Dodge City, Kan., on the morning of the 15th with areas of high barometer to the southeast and northwest. The pressure at Portland, Or., and Olympia being respectively 30.56 and 30.58. During the day the pressure decreased rapidly to the north and east of the centre, and at the afternoon report the area was well defined as central near Leavenworth, the temperature being high in the eastern quadrants and very low, with snow, from the Missouri river westward to Colorado and Wyoming. The storm increased in violence as the depression moved to the northeast, many of the observers in Iowa and the adjoining states reporting it as the most violent storm that has occurred in twenty years. The midnight report of the 15th indicated that the storm had continued its northeasterly course to the northeastern portion of Iowa, the barometer at St. Paul being 29.23, and that at Davenport 29.24. The isobarometric lines of 29.30, 29.40, 29.50 and 29.60 completely inclosed the depression in the Upper Mississippi valley and the Upper Lake region. At this report heavy snow, blockading railway trains, were reported in the region between the Mississippi and the Missouri river, and more than one inch of rain fell at St. Louis, Madison, Indianapolis, Toledo and Cairo. The course changed to the north during the night and the pressure at the centre continued to decrease until it reached 28.85 at St. Paul and 28.86 at La Crosse, the barometric gradient at this time being about four-tenths of an inch for one hundred miles. During the 16th this storm continued, with great violence, in the Lake region, but observers report that many vessels were saved by the warnings given by the cautionary signals which were displayed at the lake ports in advance of this storm. When the wind shifted to the southwest it increased in force, reaching 60 miles per hour at Milwaukee, 48 miles at Grand Haven and 45 miles at Escanaba in the afternoon of the 16th. The observer at Chicago reports: "The wind continued with but slight abatement until 2:15 a. m. of the 17th. One unknown schooner reported sunk out in the lake a short distance from port; owing to the timely warning this is the only serious disaster yet reported to shipping in South Chicago. 'North Chicago Rolling Mills', partially built, walls fourteen inches thick, blown down, burying several men in the ruins. The steamer *Alpena* which left Grand Haven on the night of the 15th with 60 passengers, is also believed to be lost. This vessel was seen from other vessels 30 miles from Chicago. Almost all vessels arriving at port bear evidence of rough usage. The height of the waves and the fury of the storm is the subject of general comment among all mariners." The observer at Escanaba reports: "Three-masted schooner *Evening Star* went ashore on the west side of the bay and was landed clear out of the water, wind from east in early morning, veered to southwest at 8 a. m., on the 16th increasing in force, reaching the maximum, 45 miles per hour at 2:30 p. m., when the wind vane was blown from the roof." The storm continued in the Upper Lake region during the 17th and extended over the Lower Lake region. The observer at Buffalo reports:—"A maximum velocity of 48 miles from the west at 6 p. m., and the gale continued until 2:30 p. m. of the 18th. A large number of vessels remained in this port by advice given upon the receipt of the special telegram from the central office announcing a severe storm. Favorable comments were made upon the display of this signal and the absence of disasters in this vicinity was attributed to the timely display of the signal." The storm seems to have been most violent on Lake Michigan where the wind forced the water to the lower end of the lake, causing it to rise eight or ten feet above the usual level, thus driving vessels ashore and destroying property near the lake. Reliable estimates have been made which place the value of property lost at a little more than half a million of dollars; 84 vessels were wrecked and 93 lives lost, more than four-fifths of all losses occurring on Lake Michigan. As the centre passed to the northeast of Lake Superior the temperature fell decidedly in the western quadrants, accompanied by snow throughout the Lake region and southward to Kentucky, and killing frosts occurred as far south as the northern portion of the Gulf States.

No. VII.—This depression was at no time central within the limits of the stations of observation, and probably developed in the Saskatchewan region and passed eastward to the lower St. Lawrence valley during the 20th and 21st, moving first to the southeast and then north of east as it approached the coast. Signals were ordered for the Lake stations and were generally justified, although no violent winds were reported.

No. VIII.—Threatening weather and heavy rains on the South Atlantic coast on the 21st, indicated the approach of this depression, and at the midnight report it was probably central near latitude 30° north, and longitude 4° east of Washington. Easterly winds of 43 miles at Cape Hatteras and 40 miles at Cape Lookout, were reported with heavy rains on the coast between Cedar Keys and Norfolk. The pressure decreased on the Middle and East Atlantic coasts during the night of the 22nd, with rain extending to the north as far as Philadelphia. The wind had increased to 41 miles from the NE. at Cape Henry, and at Cape Lookout it had shifted to the N. with a velocity of 42 miles. The barometer fell rapidly on the Middle Atlantic coast during the 22nd, the pressure at the Deleware Breakwater being 29.69 at 3 p. m., with the wind from the NE., 48 miles. The shifting of the wind to the NW. at Hatteras indicated that the centre had passed to the north of that latitude, and that

it was not far to the east of the coast. During the night of the 22nd the wind shifted to the NW. at stations south of New England, and the barometric gradient increased rapidly in front of the storm as the centre approached the New England coast. Rain and snow prevailed in the Lower Lake region, Middle States and New England, on the 22nd and 23rd, and dangerous winds occurred at all coast stations north of Wilmington, N. C. The barometer continued to fall at the centre until the storm reached the coast line, near Portland, on the morning of the 23rd, when the reading was 29.26. Severe easterly gales were reported from the St. Lawrence valley, New Brunswick and Nova Scotia. The maximum velocity report at Eastport was 53 miles from the E., 42 miles at Father Point, high winds at Quebec and 33 miles from the N. at Saugeen. After reaching the coast of Maine the course changed to the N., and by midnight of the 23rd the centre had passed to the lower St. Lawrence valley near Father Point. Cautionary Signals were ordered at all stations on the Lower Lakes and on the Atlantic coast, and were justified at all stations north of Wilmington.

No. IX.—This depression developed in the Upper Missouri valley, while the preceeding one (No. VIII,) was central in the Gulf of St. Lawrence. It moved almost directly east over the parallel of 45° until it passed to the east of the Atlantic coast on the 27th. During the 25th the centre moved from Dakota to the Upper Lake region, its approach having been announced by the display of Signals at the lake ports. The centre passed over Lake Michigan immediately north of Milwaukee, the area of rain extending south to Tennessee and east to the Atlantic coast. The Cautionary Signals displayed were generally justified, except in New England.

No. X.—This storm developed in the tropics and was central in the Gulf of Mexico, east of Brownsville at the p. m. report of the 27th. Heavy rains and cold northerly winds prevailed on the Texas coast. Indianola reported a maximum velocity of 56 miles on the 27th. The "norther" continued on the Texas coast as the centre moved toward the Mississippi and the area of rain extended north to the Ohio valley and the southern portion of the South Atlantic States on the 28th. The average hourly velocity of this storm was 19 miles, in a northeast direction over a course nearly parallel to the coast. Rain fell in all districts east of the Mississippi, the rain-fall being greatest in the Southern States and near the centre of the storm as it moved over the Middle States and New England. The barometer fell rapidly as the depression moved to the northeast and at the p. m. report of the 31st, a large area including the greater portion of New England, was completely inclosed by an isobarometric line of 29.30. Over an inch of rain fell during the last eight hours of the 31st at Portland, Eastport and Father Point. A maximum velocity of 40 miles from the SE. was reported at Eastport, when the centre was to the northwest of this station in Maine. The Cautionary Signals displayed in advance of this storm gave timely warnings and were of great service, especially at the ports on the northeast coast.

No. XI.—This depression was first observed in the Northwest, near the northern boundary of United States, at the p. m. report of the 27th, and continued in that region until the midnight report of the 28th, when it apparently joined an area which had passed from the Pacific coast. This depression although extended, was slight and after moving slowly to the east until the p. m. report of the 29th, disappeared.

No. XII.—This was a slightly marked area central in the interior of California on the 28th, and the movement to the east can be readily traced on the Study-Map of "Departures from the Normal." It appears to have united with the preceeding one, near Deadwood, at the midnight report of the 28th.

INTERNATIONAL METEOROLOGY.

Three International charts, Nos. IV, V and VI, accompany the present Review. They are for the months of *September*, 1880 and *February*, 1879.

Chart No. IV.—On this *preliminary* chart are shown, as well as is at present possible, the tracks of some of the principal storms centres over the North Atlantic Ocean and adjacent land areas during the month of *September*, 1880. Nos. I and II are the extended tracks of the tropical storms already described in previous *Reviews*. It seems probable that these storms united in forming a large area of low barometer over the northwestern portion of the Atlantic during the 6th, and which moved slowly eastward, unaccompanied by severe winds, until it disappeared on the 11th to the northwest of Scotland. The high barometer prevailing to the northward of the centres of the two cyclones above referred to may be here noted as an interesting feature in connection with the two storms, and by which the severity of the winds in the northern quadrants were increased. Thus on August 27th and 28th, while the former cyclone was approaching the coast of Florida, high pressures (from 30.20 to 30.30) were prevailing throughout the Atlantic States and Canada, and during the first few days of September, while the latter cyclone was moving eastward from the Bermudas high pressures, increasing on September 2nd to 30.35, prevailed between it and Newfoundland. The disturbance formed by the probable junction of these cyclones was preceded over the northeastern portion of the Atlantic by a somewhat severe storm, whose path is shown on the chart as No. IV. It appeared on the morning of the 3rd. Bark *Carrie Heckle* reports 3rd, 7:35 a. m., W. T., 50° N. 26° W., barometer 29.70, S. by W., fresh, threatening; 4 p. m., G. T., wind came from the north and blew a gale all night, accompanied by very heavy rain-squalls; early on the morning of the 4th, barometer rising, the wind backed to WNW., with clearing weather. On the 4th, S. S. *Indiana*, in

52° N. 22° W., reported barometer 29.30, SW. force 8, heavy NW. sea. This area of low pressures is interesting by reason of its breaking the regime of high pressures and consequent fine weather, which had prevailed over northwestern Europe, and especially over the British Isles, during the greater part of August, or since the passage of area No. III, of chart IV, September Review. The *Bulletin* of the Central Meteorological Bureau of France states that in France, the winds, which since August 10th had been easterly changed to westerly on the morning of September 5th. The next Atlantic storm (No. V.) moved in a northeasterly path, central at some distance off the American coast, and was noticed in the September REVIEW as low area No. II. This storm probably originated north of the Bahamas on the 7th. On the 8th, hurricane winds from SW. were experienced in 33° N. 73° W. by Barks *New Light* and *Eastern Star*, while further northward the hurricane winds were first experienced from the eastward. Steamer *Arrow* in 34° 40′ N. 74° W., very near the centre, but evidently in the north quadrants, reported: 8th, 2 a. m., barometer fell to 29.40, with wind blowing hard from southward; 3 a. m., barometer falling fast, wind veered to SE., with violent squalls and heavy confused seas; 4 a. m., 29.15, wind "veering" rapidly from E. to NE., N. and NW.; 6 a.m., barometer rising; 8 a. m., rising steadily, wind WNW., with heavy confused seas. Brig't. *T. H. A. Pitt*, in eastern quadrants, reports: 8th, 42° 05′ N. 64° 30′ W., NE. breezes, cloudy; 6 p. m., wind freshening, thick rain; midnight, NE. fresh gales, barometer 30.00, wind increasing rapidly and hauling southerly; 9th, 3 a. m., 29.50, perfect hurricane; 5 a. m., 29.40, wind SSW.; 10 a. m., wind moderating and hauling to westward. On the 9th, it passed eastward south of Nova Scotia as a very severe storm, but with the pressure apparently increasing. S. S. *Britannic* reports, 9th, 44° N., 58° W., 9 a. m., 30.24, SSE. force 4; 10 a. m., 30.13, wind increasing, heavy rain; noon, 30.06, strong breeze, heavy rain; 2 p. m., 29.85, wind suddenly hauled to SW. and increased to a violent gale, sea rising rapidly causing the vessel to plunge and labor heavily and filling decks with water; 4 p. m., 29.85, similar weather; 6 p. m., 29.95, wind and sea moderating. On the morning of the 10th, low pressures were experienced at St. John's, Newfoundland, and during the day, stormy weather from the SW. prevailed in 48° N., 45° W., as the storm probably passed to the northward. The next storm (No. VI) which followed quickly in rear of the preceding, and was noticed in the September REVIEW as low-area No. III, does not appear to have been as severe a storm while over the western Atlantic, but to have rapidly developed an increase of energy during the 13th, as it approached the European coast. Several reports are to hand of hurricane winds on this day over the eastern Atlantic, between 45° and 55° N., but the following record will serve to show the severity of the storm. S. S. *Scythia*, 13th, 7:35 a. m., W. T., 51° N., 15° W., 29.74, SW'ly. 4, frequent showers and high cross sea; 4 p. m., 29.27, SSW., strong breeze, heavy rain; 6 p. m., wind shifted to WNW; 6:50 p. m., lowest barometer, 28.82; 8 p. m., 29.05, NNW. moderate gale; 8:30 to 10 p. m., gale, with heavy rain, sea running high, very fierce squalls; midnight, 29.35, moderate gale, sea still high; 14th, 4 a. m., 29.65, N. strong gale, heavy sea; 7:35 a. m., W. T., 50° N., 21° W., 30.04, NNW., 7, heavy rain, rough sea. During the 14th, 15th and 16th, this area moved eastward to the English Channel as a very severe storm, a wind force of 9 (scale 0-9) being recorded during these days at Scilly, Cherbourg and the Hague. Severe north gales prevailed in its rear, and on the summit of Pic-du-midi; during the night of the 16th, the temperature fell to —3°.2 C., or 26°.2 F., with snow. In general, during the 15th and 16th, quite high pressures prevailed over the ocean. S. S. *Scythia*, in 49° N., 29° W., reporting a barometric reading of 30.57 and ship *Jumna* in 51° N., 39° W., 30.45, on the 15th, and S. S. *Illinois* in 44° N., 45° W., 30.42 on the 16th. During these days, the area of low barometer, already described in the September REVIEW as low-area No. V. and shown on the present chart as area No. VIII moved northward over New England, New Brunswick and Labrador, and on the 17th, a new depression (No. IX) appeared over the eastern half of the ocean, which subsequently moved eastward to Denmark. On the 23rd, the low-area described in the September REVIEW as area No. VIII, had moved to the eastward of Newfoundland and on the 24th, formed an extensive area of low pressures, which apparently included the greater part of the ocean between the 40th and 60th parallels. On the 25th, the region of minimum pressure had advanced eastward to the 25th meridian, but on the 26th, is found more to the westward, near the 40th meridian and in the position indicated on chart by area No. XIV. During the rest of the month, this area remained central over mid-ocean, and on the night of October 1st, was marked by severe southerly gales at the Azores, during which, the three steamers *Benalla*, *Robina* and *Stag* foundered off St. Michaels.

Chart No. V.—Upon this chart are shown the mean pressure, mean temperature, mean force and prevailing direction of the wind at 7:35 a. m., Washington time (0:43 p. m., Greenwich time) for *February*, 1879, over the Northern, and, at a few isolated stations, in the Southern Hemisphere. A zone of comparatively *high pressures* apparently extending from the eastern coast of Asia westward over that continent, over northern Africa, where, however, it is broken through lack of observations, over the southern half of the Atlantic, and thence over the United States to the Pacific. The regions of greatest pressure are found over the centre of Asia, (above 30.30 or 769.6) over the southeastern portion of the Atlantic (30.30) and over the interior of North America (30.20 or 767.1.) An extensive region of *low pressures* covers the Atlantic north of the 45th parallel and almost the whole of Europe, reaching from Labrador and Nova Scotia on the west to the Ural Mountains and Black Sea on the east. The region of minimum pressure (under 29.50 or 749.3) includes Iceland, Ireland and the western coast of Scotland. Com-

paratively low means are found at the mouth of the Amoor and near the Equator, as shown by observations at Nikolaievsk; near the isthmus of Panama; along the west African coast from 10°N to 10° S; at Natal; Mauritius; in southern Hindostan and at the Philippines. The *winds* may be classed as *northerly* or *westerly* and *northeasterly*. Over North America the direction is *northwesterly*, trending to northerly along the Gulf and South Atlantic coasts and to westerly over Canada; this westerly current extends over the whole Atlantic between the 35th and 55th parallels inclining to southwest near mid-ocean and along the European coast, the latter direction being sustained over all of southern Europe, and over southern Russia inclining still more to southerly. The *northeasterly* current predominates over the Atlantic south of 30° N from the West Indies to the coast of Africa; over the extreme northern portions of the Atlantic and Europe from Godthaab, Greenland, to northwestern Russia, and along the western coast of Asia from Niphon to the China Sea. The region of *greatest cold* appears to be over British America, the monthly mean (7:35 a. m. Washington time) of York Factory being —33°. The absolutely highest and lowest barometer readings (corrected and reduced) reported by the co-operating observers were 31.00 or 787.3 on the 24th at Ekaterinburg and 28.44 or 722.4 on the 10th by S. S. Leipzig, in 49°.03′ N. 15°.20′ W., showing a total monthly barometric range over the Northern Hemisphere of 2.56 inches. In the monthly weather review of the *Deutsche Seewarte*, for this month the lowest reading reported is 711.6 or 28.02 on the 9th on board Steamer *Donau* in 49° N. 30° W., while the highest reading reported in the *Bulletin* of the Cent. Phys. Obsy. of St. Petersburg is 791.1 or 31.15 at Irkutsk on the 27th, showing a range of 3.13 inches. On board the *Vega*, frozen in in 67° 7′ N., 173° 30′ W., the mean temperature of the month was —13°.1 F. or —25°.1 C.; the maximum pressure 31.03 or 788.1, was recorded at 6 a. m. of the 17th. Upon comparing the present chart with the one presenting similar means for the same month of the previous year, the greatest changes are found over the Atlantic ocean and Europe and over the Behring's Sea region. Instead of the two areas of low barometer in 1878, located, respectively, over the western portion of the Atlantic and to the north of Norway, there is now found one large area over the extreme northeastern part of the ocean, which, extending its influence southeastwardly over Europe, produces a diminution of pressure over the western and central portions of that continent of from 0.50 to 0.60 of an inch, at the same time that an increase in pressure (amounting to about 0.35 inch) is found over northeastern Europe and in the Ural region. As a result of this changed distribution of pressure, the temperature over northern Europe, under the influence of the easterly current referred to above, underwent a decided diminution, amounting to about 10° F. over Finland, Scandinavia and the North Sea, and about 5° over the British Isles, Iceland and contiguous portion of the Atlantic. Towards the centre of Europe, the diminution in temperature is less marked, and at extreme south and in the southeast a decided increase is noted, which at Beirut, amounts to 10° F. Over the Atlantic, in the region occupied by the low-pressure of 1878, a barometric rise of 0.30 to 0.50 inch is noted, with an apparent slight increase of temperature. Over the North American continent, there is also a general increase in pressure amounting in Alaska to 0.60; in Washington Territory to 0.30 and from Manitoba to the Gulf States, to about 0.20 inch, with a large decrease of temperature over the whole region east of the Rocky Mountains. At York Factory, the temperature in 1878 was —1°.7 and in 1879, —33°. Over Asia, and especially along the Chinese coast, the pressure is diminished, the decrease amounting to 0.17 at Pekin and 0.15 at Shanghai. At the same time, in the latter region, the winds which were NW. in 1878, are now SE'ly., with an increase in temperature of 5° at Hong Kong, 4° at Shanghai and 19° at the mouth of the Amoor. Notwithstanding the great increase of pressure (0.60 in.) at St. Michael's, Behring's Sea, the temperature at this station shows an increase of 13°. As compared with the preceding month, January, 1879, the the most marked changes are: 1st, the change of position of the low-area over the Atlantic from the Northwest to the Northeast and a removal of the high pressure from Europe; 2nd, the large increase in pressure of more than half an inch over the Behring's Sea region; and 3rd, a decided contraction of the area of high pressure over Asia.

Chart No. VI.—Upon this chart are traced the paths of 27 of the principal storm-areas of the northern hemisphere, during the month of *February*, 1879. Of these, 8 are located along the eastern coast of Asia, or over the Behring's Sea region; one over central Asia, and the remainder (18) over North America, the north Atlantic or Europe. Of the 12 over North America, one, No. I, properly belongs to the preceding month, as it cannot be traced after the morning of the 1st; two, Nos. VII and XIV, appeared over Hudson Bay, and are based upon the reports of York Factory and Moose Factory; five, Nos. VIII, X, XVII, XXV and XXVII, developed or first appeared in the Rocky Mountain region; three, Nos. XI, XVIII and XXI, appeared on the Pacific coast on the 8th, 17th and 20th, respectively, and subsequently crossed the continent, and one, No. IV, appears to have slowly developed over the Canadian maritime Provinces in the trough of low pressures left by area No. XXVIII, of January. Of the low areas leaving the American coast, the unusually large number of five can be traced across the Atlantic to the vicinity of the European coast; two, Nos. XVIII and XXV, passed northward over Newfoundland and Labrador, respectively, towards Davis Straits, while two, Nos. I and XVII, appeared to die out over the western portion of the ocean. Of the European storms, four, Nos. III, VIII, X and XI, can probably be traced back to the American coast; two, Nos, VI and XVI, first appeared, respectively, over Norway and the British Isles, and one, No. XV, over the Gulf of Bothnia; two, Nos. XXIII and XXIV, appeared successively on the 23rd and 24th,

over southern Europe and Algeria, and subsequently moved in very similar paths north-northeastward to the Baltic. Of the six areas located on the eastern coast of Asia, three, Nos. II, IX and XIII, occurred during the first portion of the month, and are, from their positions, necessarily poorly defined, as was also No. XIX, which probably passed eastward over Niphon during the night of the 18th. Nos. XXII and XXVI, occurring respectively from the 21st to the 25th, and from the 26th to the 1st of March, were, however, pretty well marked areas, and the general direction of the paths, as well as the positions of the centres, are probably almost correct. The first of these, namely, No. XXII, appears to have developed during the 21st over the China Sea region, on which day the barometers at Hong Kong, Manilla and Shanghai, registered the second decided minima of the month. During the 22nd it was followed at Manilla and Shanghai by NW. winds, (the only NW. wind of the month reported from the former station,) and moved towards the NE., apparently only a short distance off the coast of Niphon, and thence northward to the Okhotsk Sea. The lowest barometer-readings of the month occurred at the following stations during the passage of this area, and in the order given:

STATIONS.	Date.	Time.		Barometer.		Winds.		
	Feb. 1879.	*Local.*	*Wash. mean.*	*Inches.*	*Mm.*	(1)	(2)	(3)
Manilla	21st	8:47 p. m.	7:35 a. m.	29.80	757.0	SSE.—	SSE.—	NW.
30° N. 129° E., S. S. Belgic	21st	9:19 p. m.	7:35 a. m.	29.77	756.2	(—)—	SSW.—	(—)
Nagasaki	22nd	3:30 p. m.	1:42 a. m.	29.62	752.3	WSW.—	NNW.—	N.
Hiroshima	22nd	3:30 p. m.	1:22 a. m.	29.60	751.8	S.—	NNE.—	NW.
Kobe	22nd	9:43 p. m.	7:35 a. m.	29.46	748.3	N.—	NE.—	NNE.
Yokohama	23rd	11:30 a. m.	9:02 p.m., 22nd	29.05	737.9	N.—	N.—	N.
Tokio	23rd	9:30 a. m.	7:02 p.m., 22nd	29.07	738.5	NW.—	NNW.—	NNW.
Nikolaievsk	24th	7:00 a. m.	10:07 p.m., 24th	29.40	746 7	W.—	W.—	S.

The wind directions are for the observations at times of lowest barometer (2) and for the same hours of the preceding (1) and succeeding (3) days. At Nagasaki the wind, at 3:30 p. m. of the 21st, was from WSW. as given in table but at 9:10 p. m. it was NE. At Tokio a similar change occurred, the wind at 9:30 a. m. 22nd being NW. and from 3 to 4 p. m. NE; at 3 a. m. 23rd, it veered N. to NNW. and increased to its maximum velocity (29 miles per hour) at 11 a. m.. The heaviest rains of the month were also recorded during the regime of this storm. Nagasaki recording 2.30, Hiroshima, 1.40, Yokohama, 2.96, and Tokio, 3.01 inches. Steamer *Belgic*, from Yokohama to Hong Kong, encountered the storm during the 21st and 22nd; on the latter date she was in 28° 43′ N, 125° 34′ E. and had barometer 29.85, wind N., force 7 (0–12) with rough, cross and turbulent sea. The area No. XXVI appears to have developed over the interior of China, and to have moved in a path somewhat to the north of Shanghai and the Island of Niphon. The following table gives data for this storm similar to the above:

STATIONS.	Date.	Time.		Barometer.		Winds.		
	Feb., 1879.	*Local.*	*Wash. mean.*	*Inches.*	*Mm.*	(1)	(2)	(3)
Pekin	25th	8:27 p. m.	7:35 a. m.	30.02	762.4	Calm—	SW.—	Calm.
Tientsin	25th	8:32 p. m.	7:35 a. m.	29 95	760.8	E. by N.—	E.—	ENE.
Macao	26th	8:19 p. m.	7:35 a. m.	29.89	759.2	ENE.—	NE.—	SW.
Shanghai	27th	2:00 p. m.	12:46 a. m.	29.74	755.4	SE.—	WSW.—	NW.
Manilla	26th & 27th	8:47 p. m.	7:35 a. m.	29.82	757.4	SSE.—	ESE.—	SW.
Nagasaki	28th	3:30 p. m.	1:42 a. m.	29 64	752.9	SE.—	SE.—	NW.
Hiroshima	28th	9:30 p. m.	7:32 a. m.	29.78	756.4	(—.)—	N.—	NNE.
Kobe	28th	8:47 p. m.	7:35 a. m.	29.91	759.7	ESE.—	SE.—	WNW.
Vladivostok	*Mar.* 1st	7:00 a. m.	7:04 p. m., 28th	29.86	758.3	ESE.—	N.—	Calm.
Yokohama	1st	10:00 p. m.	7:35 a. m., 1st	30.03	762.7	S.—	Calm—	NNE.
Tokio	2nd	3:30 a. m.	12:52 p. m., 1st	29.92	760.0	SE.—	N.—	NE.
Nikolaievsk	2nd	7:00 a. m.	4:18 p. m., 1st	29.54	750.4	Calm—	E.—	Calm.

This area was followed along the coast of China by severe northerly gales and snow. At Tientsin the wind reached a force of 8 (scale 0 to 12); at Tchefow, on the southern coast of the Gulf of Petchely, a violent northerly gale and high tide were experienced; at Shanghai it reached 30 miles per hour at 2 p. m. of the 28th, and at Vladivostok, force 8 (0–12) on the morning of March 1st. From the preceding data the progressive velocities of the centres of these two storms may be estimated at about 25 miles per hour.

In Behring's Sea region high pressures predominated during the greater part of the month, and only three low areas, Nos. II, V and XII, are indicated on the chart. The two former were quite severe storms; the wind at St. Michael's on the 2nd reached 67 miles per hour from the south, and at St. Paul's Island on the 6th, 49 miles from the southeast. After the disappearance of area No. II on the 7th, a decided rise of barometer set in at these stations which continued almost uninterrupted at St. Michael's until 3 p. m. of the 17th, when the barometer read 30.859; at St. Paul's there was a slight interruption on the 10th and 11th, but the pressure recovering, the maximum, 30.679, was reached at 9 p. m., 17th, and 7 a. m. of the 18th; after these dates the barometer fell at both stations until the 22nd. During the regime of this extraordinary high barometer area, northerly winds and gales prevailed and at St. Michael's the temperature fell to —30° on the 18th. After the 22nd lower pressures were experienced with the centre of depression apparently to the southeast of the stations.

TEMPERATURE OF THE AIR.

The mean temperature of the air during October, 1880, is shown by the isothermal lines in red on chart No. II. In the Southern States east of the Mississippi river, and in the Middle States, the

temperature has been near the normal of many years. In all the other districts east of the Rocky Mountains it has averaged from one to five degrees below the normal, the greatest departures being in western Texas and thence northward over Kansas and Colorado. On the Pacific slope the temperature corresponds with the normal, except at San Diego, where it is one degree below, and in the southern Plateau district, where it has averaged over two degrees below. The temperature is slightly above the normal in the lower St. Lawrence valley and Gulf of St. Lawrence.

The following are the maximum and minimum temperatures reported in each State and Territory:

Maximum Temperatures.—Alabama: 87° at Montgomery. *Arizona:* 97° at Yuma. *Arkansas:* 82° at Little Rock. *California:* 90° at Visalia, 89° at Los Angeles, 88° at Red Bluff and 100° at *Mammoth Tank. *Colorado:* 87° at *Trinidad and 79° at Denver. *Connecticut:* 75° at New Haven. *Dakota:* 94° at *Fort Randall and 84° at Yankton. *District of Columbia:* 81° at Washington. *Florida:* 90° at Key West and 88° at Punta Rassa. *Georgia:* 88° at *Forsysh and 85° at Augusta. *Iowa:* 83° at *Fort Madison and 79° at Keokuk. *Idaho:* 85° at Boise City. *Illinois:* 90° at *Sterling and 79° at Springfield. *Indiana:* 82° at *Vevay, and 78° at Indianapolis. *Indian Territory:* 84° at Fort Sill. *Kansas:* 86° at Dodge City. *Kentucky:* 80° at Louisville. *Louisiana:* 92° at *Lake Charles and 85° at Shreveport. *Maine:* 72° at *Surrey and 71° at Portland. *Maryland:* 81° at Baltimore. *Massachusetts:* 80° at Boston. *Michigan:* 81° at *Lansing and *Northport, and 76° at Alpena. *Minnesota:* 84° at Breckenridge. *Mississippi:* 89° at Vicksburg. *Missouri:* 83° at St. Louis and *Ashley. *Montana:* 81° at Fort Benton. *Nebraska:* 87° at North Platte. *Nevada:* 81° at Winnemucca and 88° at *Hot Springs. *New Hampshire:* 73° at *Contoocookville and 50° on summit of Mount Washington. *New Jersey:* 83° at *Atco and 79° at Barnegat. *New Mexico:* 92° at La Mesilla. *New York:* 84° at *Friendship and 81° at Rochester. *North Carolina:* 83° at Charlotte and Wilmington. *Ohio:* 86° at *Jacksonburg and 79° at Cleveland. *Oregon:* 86° at Umatilla. *Pennsylvania:* 84° at *Egypt and 82° at Philadelphia. *Rhode Island:* 70° at Newport. *South Carolina:* 82° at Charleston. *Tennessee:* 82° at Knoxville. *Texas:* 91° at Rio Grande and 88° at Fort Elliott. *Utah:* 77° at Salt Lake City. *Vermont:* 77° at *Charlotte and 72° at Burlington. *Virginia:* 86° at *Johnsontown and 82° at Norfolk. *Washington Territory:* 73° at Olympia. *West Virginia:* 76° at *Helvetia and *Flemington, and 75° at Morgantown. *Wisconsin:* 77° at Milwaukee *Wyoming:* 74° at Cheyenne.

Those marked with a star (*) are reported by U. S. Army Post Surgeons or Voluntary Observers.

Minimum Temperatures:— Alabama: 38° at Montgomery. *Arkansas:* 32° at *Mt. Ida. *Arizona:* 18° at Prescott. *California:* 26° at Campo and 28° at *Summit. *Colorado:* —12° on summit of Pike's Peak and 12° at *Ft. Garland. *Connecticut:* 30° at New Haven. *Dakota:* 9° at *Ft. Stevenson and 12° at Bismarck. *District of Columbia:* 30° at Washington. *Florida:* 40° at *Houston and 46° at Jacksonville. *Georgia:* 32° at *Gainesville and 39° at Augusta. *Iowa:* 13° at *Nora Springs and 22° at Dubuque. *Idaho:* 15° at *Ft. Hall and 24° at Boise City. *Illinois:* 17° at *Elmira and 26° at Springfield. *Indiana:* 26° at Spiceland and 31° at Indianapolis. *Indian Territory:* 31° at Ft. Sill. *Kansas:* 21° at *Holton, *Topeka and *Yates Centre, and 27° at Dodge City. *Kentucky:* 34° at Louisville. *Louisiana:* 43° at Shreveport. *Maine:* 22° at *Cornish, *Orono and *Gardner and 29° at Eastport. *Maryland:* 23° at *Woodstock and 35° at Baltimore. *Massachusetts:* 21° at *Rowe, *Westborough and *Williamstown, and 25° at Springfield. *Michigan:* 24° at Escanaba and *Kalamazoo. *Minnesota:* 15° at Breckenridge. *Mississippi:* 40° at *Fayette, 43° at Vicksburg. *Missouri:* 25° at *Ashley and *Corning, 28° at St. Louis. *Montana:* 10° at Virginia City. *Nebraska:* 20° at *Genoa and 25° at North Platte and Omaha. *Nevada:* 13° at Winnemucca and 12° at *Palisade and *Otego. *New Hampshire:* 4° on summit of Mt. Washington and 16° at *Grafton. *New Jersey:* 28° at *Linden and *Somerville, and 30° at Atlantic City. *New Mexico:* 16° at Santa Fe. *New York:* 22° at *Argyle and Waterburg, and 29° at Buffalo. *North Carolina:* 26° at *Lenoir and *Highlands, and 33° at Charlotte. *Ohio:* 21° at *Westerville and 29° at Columbus. *Oregon:* 29° at Roseburg and Umatilla. *Pennsylvania:* 22° at *Franklin, 30° at Pittsburg. *Rhode Island:* 33° at Newport. *South Carolina:* 45° at Charleston. *Tennessee:* 31° at Knoxville. *Texas:* 26° at Ft. Elliott and 47° at Rio Grande. *Utah:* 27° at Salt Lake City. *Vermont:* 14° at *Woodstock and 25° at Burlington. *Virginia:* 23° at *Snowville, 31° at Lynchburg. *West Virginia:* 21° at *Flemington and 31° at Morgantown. *Wisconsin:* 17° at *Neillsville and 26° at Madison. *Wyoming:* 3° at *Ft. Bridger and 20° at Cheyenne.

Those marked with a star (*) are reported by U. S. Army Post Surgeons or Voluntary Observers.

Ranges of Temperature at Signal Service Stations.—The *monthly ranges* will appear from the *maxima* and *minima* just given. The greatest *daily ranges* vary in New England from 18° at Eastport and Wood's Holl to 33° at Boston. Middle Atlantic States, 19° at Chincoteague to 28° at Albany, and 33° at Lynchburg. South Atlantic States, 17° at Cape Lookout to 29° at Charlotte, and 32° at Augusta. East Gulf States, 12° at Key West to 31° at Montgomery. West Gulf States, 18° at New Orleans to 33° at Little Rock. Ohio valley and Tennessee, 24° at Cairo to 35° at Morgantown and Knoxville, and 37° at Pittsburg. Lower Lake region, 21° at Erie to 40° at Rochester. Upper Lake region, 26° at Escanaba, Milwaukee, Grand Haven, Alpena and Port Huron to 29° at Marquette. Upper Mississippi valley, 26° at La Crosse to 33° at St. Louis and 36° at St. Paul. Valley of the Red river of the North, 40° at St. Vincent to 43° at Breckenridge. Lower Missouri valley, 33° at Omaha to 42° at Bismarck. Rio Grande valley, 30° at Eagle Pass to 36° at Rio Grande, and 42°

at Brackettsville. Texas, 27° at San Antonio to 43° at Jacksboro' and Ft. Elliott. Rocky Mountains, 25° on summit of Pike's Peak to 36° at Cheyenne, and 39° at Santa Fe. Western Plateau, 29° at Pioche to 37° at Boise City and 50° at Winnemucca. California, 21° at San Francisco, to 38° at Red Bluff and 40° at Visalia.

Frost has been reported very frequently from all sections north of the 35th parallel, but the extreme southern limit is described by a line passing along the southern boarder of Arizona and New Mexico reaching eastward to Concho, Tex., thence deflecting southward to the Rio Grand valley near Brackettsville. From this point it passes eastward to San Antonio and thence directly northward to the southern boundary of Indian Territory. Again deflecting eastward it passes through Vicksburg and between Mobile and Montgomery, reaching the western coast of Florida south of Cedar Keys and the Atlantic coast at Savannah.

Frost, injurious to vegitation, was reported in the various States on the following dates: *Vermont:* 29th. *Massachusetts:* 26th, 28th and 29th. *New York:* 20th and 21st. *New Jersey:* 1st, 14th and 19th. *North Carolina:* 18th, 19th, 24th and 25th. *Tennessee:* 18th. *Ohio:* 18th and 25th. *Michigan:* 28th. *Indiana:* 18th. *Wisconsin:* 13th. *Missouri:* 17th and 18th. *Indian Territory:* 4th. *Kansas:* 17th. *Wyoming Territory:* 10th.

Ground Frozen.—Oswego, N. Y., 28th. Buffalo, N. Y., 28th. Bangor, Me., 25th. Southington, Conn., 19th. Genoa, Neb., 16th. Grafton, N. H., 29th. Freehold, N. J., 19th. Palermo, N. Y., 28th. Elsworth, N. C., 25th. Cleveland, O., 18th. College Hill, O., 18th. Wooster, O., 19th. Blooming Grove, Pa., 22nd. Charlotte, Vt., 25th and 29th. Lunenburg Vt., 29th. Neillsville, Wis., 27th and 31st.

Ice formed in the various States on the following dates:—*Maine:* 14th, 15th, 18th and 25th. *New Hampshire;* 1st, 14th, 25th and 29th. *Massachusetts:* 8th, 9th, 14th and 25th. *Rhode Island and Connecticut:* 25th. *New York:* 1st, 14th, 18th to 21st, 24th to 28th. *New Jersey:* 13th, 17th to 20th, 24th and 25th. *Maryland:* 19th and 25th. *Virginia:* 18th, 19th, 24th and 25th. *West Virginia and Pennsylvania:* 19th. *North Carolina:* 18th, 25th and 26th. *Tennessee:* 23rd. *Ohio:* 7th, 8th, 18th, 19th and 25th. *Indiana:* 18th. *Michigan:* 19th, 24th and 29th. *Illinois:* 17th, 18th, 23rd and 24th. *Missouri:* 4th, 17th, 18th, 19th to 23rd. *Indian Territory:* 17th. *Kansas:* 4th, 5th, 16th to 19th. *Nebraska:* 3rd, 4th, 16th to 19th, 22nd to 24th, 28th to 31st. *Iowa:* 5th, 17th, 18th, 22nd, 23rd, 24th, 28th to 31st. *Wisconsin:* 17th, 18th, 27th, 31st. *Minnesota:* 16th and 17th. *Dakota:* 3rd, 12th and 18th. *Utah:* 10th. *Idaho:* 9th, 10th, 11th, 12th, 15th and 29th. *Washington Territory:* 10th, 11th, 15th and 16th.

PRECIPITATION.

The general distribution of rain-fall, for October, 1880, is shown on chart No. III, as accurately as possible, from about 500 reports. The table on this chart shows the *average* precipitation for October, as compared with that of the present month. East of the Mississippi river, except in the Upper Mississippi valley, Upper Lake region and Middle Atlantic States, where there were slight deficiencies, there were excesses of rain-fall, ranging from 3.36 inches in the Florida peninsula and 2.40 inches in the South Atlantic States to 0.17 in New England. West of the Mississippi, except in Minnesota and the Lower Missouri valley, where slight excesses occurred, the rain-fall was below the average, the greatest deficiency 1.47 inch, occurring in the North Pacific coast region.

Special Heavy Rains.—2nd, Leavenworth, Kan., 2.56 inches in 11 hours 25 minutes; Sterling, Ill., 2.25 in. in 9 hours 30 minutes; Jacksboro, Tex., 4.12 in. 3rd, Jacksonville, 2.25 in. 3rd and 4th, Pt. Pleasant, La., 3.01 in.; Kansas City, Mo., 2.00 in. 3rd to 11th, Mayport, Fla., 15.83 in. 4th, Vicksburg, 2.71 in.; Savannah, 2.24 in. in 7 hours 5 minutes. 7th and 8th, Jacksonville, 4.28 in. in 24 hours; Charleston, 4.59 in. 8th and 9th, Cedar Keys, 4.51 in. 9th, Cape Lookout, N. C., 3.82 in. 9th and 10th, Jacksonville, 4.03 in 20 hours 15 minutes; St. Augustine, Fla., 10.31 in. 13th, near Howard, Neb., 1.38 in. in 50 minutes; Lexington, Mo., 4.32 in. 15th and 16th, Louisville, Ky., 3.23 in: Louisville, Ill., 2.00 in. in 15 hours; Laconia, Ind., 4.70 in.; Paducah, Ky., 2.37 in. 16th, Toledo, 1.15 in. in 3 hours; Fort Barrancas, Florida., 3.07 in.; Paducah, Ky., 2.92 in. 21st and 22nd, Cedar Keys, Florida, 3.19 in. 25th, Springfield, Illinois, 0.23 in. in 6 minutes. 26th, Fredericksburg, Texas, 2.00 in. 27th, Ft. Barrancas, Florida, 3.62 in.; Helena, Ark., 2.15 in. 27th to 30th, Pt. Pleasant, La., 8.00 in. 28th, Vicksburg, 2.00 in.; Mobile, 2.84 in. 28th and 29th, Wilmington, 2.69 in. in 16 hours; Elsworth, N. C., 6.30 in. 29th, Smithville, 2.51 in. in 10 hours 10 minutes. 29th and 30th, Nashville, 2.30 in. in 25 hours 23 minutes. 30th and 31st, Springfield, Mass., 2.02 in.; Grafton, N. H., 2.45 in., 1.80 in. in 12 hours; Portland, Me., 2.69 in. in 23 hours 45 minutes; Springfield, Mass., 2.24 in. in 20 hours 5 minutes; Burlington, Vt., 2.20 in.; Antrim, N. H., 2.70 in.; Dundee, N. Y., 2.77 in.; Bristol, N. H., 3.04 in.; Lake Village, N. H., 2.97 in.

Largest Monthly Rain-falls.—Mayport, Fla., 20.03 inches; Jacksonville, 16.25; St. Augustine and Paducah, Ky., 14.29; Cape Hatteras, 12.00; Cedar Keys, 10.37; Ft. Barrancas, Fla., 9.78; Charleston, 9.19; Elsworth, N. C., 8.50; Punta Rassa, 8.10; Mt. Washington, 7.96; Cape Lookout, 7.90; Mobile, 7.32; Nashville, 7.24; Laconia, Ind., 7.20; Cairo, 6.96; Smithville, 6.62; Savannah, 6.58; Louisville, 6.39; Evansville, Ind., 6.37; Kittyhawk, 5.95.

Smallest Monthly Rain-falls.—Sacramento and Winnemucca, none; Princeton, Cal., trace; Pleasanton, Cal., 0.01; Point San Jose, 0.03 inch; Browns, Nev., and Ravenna, Cal., 0.02; San Francisco, 0.05; Red Bluff,0.08; Borden, Cal., 0.11; Los Angeles and Visalia, Cal., and Florence and Tucson, Ariz., 0.13; Ft. Bennet. Dak., and Terrace, Nev., 0.15; Phœnix, Ariz., 0.20; Ft. Assinniboine, Mont., and Keene, Cal., 0.22; Santa Monica, Cal., 0.23; Ft. Shaw, Mont., and Muscatine, Iowa, 0.25; Brackettsville, Tex., and Bismarck, 0.27; Anaheim, Cal., 0.28; Umatilla, Or. and La Mesilla, N. M., 0.35; Ft. Stevenson, Dak., 0.36; Ft. Davis, Tex., 0.38; Salt Lake City, 0.40; Uvalde, Tex., 0.44; Fort Grant, Ariz., and El Paso, Tex., 0.47; Boise City, 0.50; Milwaukee, 0.51; Ft. Sill, 0.54; Ft. Verde, Ariz., 0.57.

Rainy Days.—The number of days on which rain or snow has fallen, varies as follows: New England, 7 to 16; Middle Atlantic States, 5 to 13; South Atlantic States, 7 to 17; Eastern Gulf States, 10 to 14; Western Gulf States, 4 to 10; Ohio valley and Tennessee, 10 to 16; Lower Lake region, 14 to 22; Upper Lake region, 7 to 20; Upper Mississippi valley, 5 to 10; Lower Missouri valley, 5 to 7; Valley of the Red River of the North, 9 to 11; Rio Grande valley, 3 to 8; Texas, 3 to 7; Rocky Mountains, 5 to 17; Western Plateau, 0 to 5; California, 0 to 3; Oregon, 3 to 10; Washington Territory, 7 to 9.

Cloudy Days.—The number varies in New England from 5 to 14; Middle Atlantic States, 6 to 10; South Atlantic States, 8 to 16; Eastern Gulf States, 6 to 16; Western Gulf States, 3 to 10; Ohio valley and Tennessee, 8 to 13; Lower Lake region, 10 to 13; Upper Lake region, 8 to 16; Upper Mississippi valley, 7 to 12; Lower Missouri valley, 5 to 11; Valley of the Red River of the North, 12 to 14; Rio Grande valley, 4 to 7; Texas, 1 to 9; Rocky Mountains, 4 to 9; Western Plateau, 2 to 5; California, 1 to 3.

Hail.—New York: Madison Barracks, 6th; Buffalo, 17th, 18th. *Pennsylvania:* Catawissa, Fallsington, Philadelphia and West Chester, 28th; Green Castle, 26th. *New Jersey:* Freehold and Princeton, 28th. *Illinois:* Chicago, 1st, 2nd, 25th; Morrison and Sterling, 2nd. *Iowa:* Dubuque, 14th, 16th; Clinton, 3rd; Cresco, 15th; Mt. Vernon, 2nd. Des Moines, 15th, severest storm experienced since opening station; great damage to windows; stones varied in size from hickory nuts to walnuts; width of track one-quarter mile; direction from southwest to northeast. *Kansas:* Holton, 2nd. *Michigan:* Lansing, 2nd, 25th; Marquette, 16th. *Minnesota:* St. Vincent, 10th; New Ulm, 15th; Duluth, 28th. *Wisconsin:* Milwaukee, 25th. *Dakota:* Ft. Bennet, 15th, 16th. *Texas:* San Antonio, 27th; Pilot Point, 15th. *New Mexico:* Santa Fe, 12th. *Oregon:* Albany, 10th. *Washington Territory:* Pomeroy, 14th.

Snow.—New Hampshire: 19th, 24th, 26th; on summit of Mt. Washington, 1st, 2nd, 5th, 6th, 7th, 8th, 12th, 13th, 18th to 23rd, 25th to 31st. *Vermont:* 19th, 20th, 23rd, 25th, 28th. *Massachusetts:* 19th, 20th, 24th. *New York:* 17th, 18th, 19th, 20th, 23rd, 24th, 27th, 28th. *New Jersey:* 19th, 28th. *Pennsylvania:* 19th, 24th, 28th. *Maryland:* 19th, 22nd and 23rd in mountains. *West Virginia:* 19th, 23rd. *Kentucky:* 19th. *Ohio:* 17th, 19th, 20th, 23rd, 24th. *Michigan:* 16th to 24th, 26th, 27th. *Indiana:* 15th, 17th to 19th. *Illinois:* 16th, 17th, 19th to 23rd. *Missouri:* 16th. *Wisconsin:* 16th, 17th to 19th, 23rd. *Iowa:* 15th to 19th, 23rd. *Kansas:* 15th, 16th. *Nebraska:* 14th to 18th, 21st. *Minnesota:* 15th to 21st, 23rd, 30th. *Dakota:* 9th, 15th to 18th, 26th. *Colorado:* 9th to 13th. 15th, 26th, 30th. On summit of Pike's Peak, 9th, 11th, 12th, 13th, 18th to 24th, 31st. *New Mexico:* 10th, 11th. *Nevada:* 8th. 10th, 11th, 12th. *Utah:* 8th, 9th, 10th, 14th. *Wyoming:* 9th, 10th, 14th to 18th, 29th. *Idoha:* 14th. *Montana:* 8th, 9th, 14th, 15th, 28th.

Droughts.—Ft. Madison, Iowa, 30th, water very scarce; pastures drying up. Yates Centre, Kan., 31st, streams and ponds lower than for past six years. Emmittsburg, Md., 30th, month very dry. Sandy Springs, Md., 31st, great scarcity of water; streams unusually low. Contoocookville, N. H., 1st to 30th, quite severe. Palermo, N. Y., 18th, very dry; wells and streams low. Greencastle, Pa., last half of month streams very low; wells and springs nearly dry; boats on Delaware and Hudson Canal stopped running for want of water. Woodstock, Vt., throughout month, springs and wells remarkably low. Wytheville, Va., 29th, drought has been very severe since the 1st; cisterns and wells generally exhausted and streams very low.

Snow from a Cloudless Sky.—Springfield, Ill., 18th.

Snow on Ground at End of Month.—Virginia City, Mont., 1.50 inches; Pike's Peak, 2 ft. 2 in.; Breckenridge, Minn., trace; Mt. Washington, 4.00 in.

Rain-falls During September, Received Too Late to Be Used in September Review.—Arizona: Whipple Barracks, 0.40; Ft. Lowell, 0.38; Ft. Bowie, 1.35; Ft. Verde, 0.52; Ft. McDowell, 0.34; Ft. Apache, 0.30; Ft. Mojave, 0.07; Prescott, 1.26; Phœnix, 0.67; Florence, 0.55; Fort Thomas, 0.54; Ft. Grant, 1.01. *California:* Benecia Barracks, Point San Jose, Angel Island, Alcatraz and Presidio, none; Ft. Gaston, 0.04; Ft. Bidwell, 0.05; Campo, 0.01. *Colorado:* Ft. Lyon, 0.95; *Dakota:* Ft. Sisseton, 0.60. *Idaho:* Ft. Lapwai, 0.82; Lewiston, 0.20. *Montana:* Ft. Benton, 0.48; Ft. Ellis, 0.28; Ft. Logan, 0.60. *Oregon:* Ft. Stevens, 2.04; Klamath, 0.00. *Washington Territory:* Ft. Canby, 1.80; Ft. Townsend, 0.90; Dayton, 0.19. *Wyoming Territory:* Ft. Fetterman, 0.60.

RELATIVE HUMIDITY.

The percentage of mean relative humidity for the month ranges as follows: New England, 66 to 80. Middle Atlantic States, 61 to 86. South Atlantic States, 62 to 80. Eastern Gulf States, 68 to 77. Western Gulf States, 70 to 76. Ohio valley and Tennessee, 63 to 79. Lower Lake region, 67 to 70. Upper Lake region, 66 to 76. Upper Mississippi valley, 58 to 65. Lower Missouri valley, 62 to 64. Valley of the Red River of the North, 70 to 77. Rio Grande valley, 63 to 71. Texas, 61 to 71. Western Plateau, 30 to 45. California, 37 to 71. Oregon, 54 to 82. *High stations* report the following percentages not corrected for altitude: Mt. Washington, 80.7; Pike's Peak, 67.3; Denver, 55.9; Cheyenne, 45.0; Virginia City, 48.7; Santa Fe, 48.0.

WINDS.

The arrows on chart No. II indicate the prevailing direction of the wind at the several stations during the month of October. The prevailing direction was *north* to *east* in the South Atlantic and Gulf States, in the southern portion of the area of mean high barometer for the month, and *south* to *west* in the Lake region, Ohio valley, Northwest and interior of Texas, the Middle States and New England. *Northerly* winds prevailed on the Pacific coast as far south as Sacramento, and *southeast* to *southwest* winds in the southern portion of California. At stations in the Rocky Mountain region the prevailing direction was generally from the higher to lower altitudes. Pike's Peak, prevailing direction, northwest; highest velocity, 72 miles, west on 13th. Mount Washington, prevailing direction, northwest; highest velocity, 84 miles, northwest, on the 24th and 31st.

Total Movements of the Air.—The following are the *largest* total movements in the various districts: Pike's Peak, 13,984 miles; Mount Washington, 13,392, incomplete on account of frost-work; Cape Lookout, 12,809; Delaware Breakwater, 11,762; Cape May, 11,803; Chincoteague, 10,985; Kitty-hawk, 10,765; Wood's Holl, 10,669; Cape Hatteras, 10,497; Block Island, 10,341; Sandy Hook, 10,299; Sandusky, 10,294; Thatcher's Island, 10,084; Portsmouth, 9,907; Cape Henry, 9,625; Milwaukee, 9,466; North Platte, 9,379; Barnegat, 9,125; Indianola, 9,071. The *smallest* are: La Mesilla, 700 miles; Roseburg, 1,402; Silver City, 2,008; Visalia, 2,937; Augusta, 2,060; Shreveport, 2,113; Uvalde, 2,146; Lynchburg. 2,181; Los Angeles, 2,423; San Antonio, 2,627; Nashville, 2,669; Eagle Pass, 2,818; Olympia, 2,842; Boise City, 2,864; Portland, Or., 2,975; El Paso, 3,128.

Local Storms—No storms under this head of decided severity were reported during the month except in connection with the passage of low area No. VI, during the 15th, 16th and 17th, which are herewith appended from the reports of various stations and other sources. Morrison, Ill., 16th, violent storm, hundreds of trees prostrated and considerable damage to fences and out-buildings. Riley, Ill., 16th, great damage to trees, fences, corn-fields and a "wholesale destruction of windmills;" heaviest storm ever experienced here; estimated velocity of wind 70 miles per hour. Rockford, Ill., 16th, severe gale from the southwest, causing considerable damage. Elmira. Ill., 16th, violent southwest gale nearly all day. Springfield, Ill., 16th, considerable damage to trees, fences and out-buildings. Chicago, 16th, violent southwest gale with sleet from 5.15 to 9.30 p. m., buildings blown down and much damage to shipping; 17th, wind continued high all day. Independence, Iowa, 16th, snow accompanied by a violent westerly gale from 1 to 11 p. m. Guttenburg, Iowa, 15th, severe thunder-storm, creeks in vicinity rose 11 feet above low-water mark; 16th, hurricane from west, accompanied by sleet. Logan, Iowa, 16th, violent westerly gale, worst storm for twenty years. Mt. Vernon, Iowa, violent westerly gale all day. Nora Springs, Iowa, 16th, lowest barometer ever recorded, storm of great severity, all railroad communication westward suspended. Muscatine, Iowa, 16th, very heavy west gale. Cresco, Iowa, 16th, heavy westerly storm, lowest barometer for the year. Vail, Iowa, 16th, storm of unusual severity; snow-drifts from three to five feet deep. Mitchellville, Iowa, 15th, about 4 p. m. a tornado was noticed in the west coming rapidly in direction of town, accompanied by a deep, heavy rumbling sound. The cloud, funnel-shaped and twisting with great radidity, was accompanied by a heavy westerly gale, and sudden darkness overshadowed everything as it approached the western edge of the village, where it lifted from the earth and passed harmlessly to the northeast, when it again seemed to descend. Dubuque, Iowa, 16th, violent southwest wind, considerable damage to trees, fences and out-buildings. Keokuk, Iowa, 15th, southwest 48 miles, considerable damage to property; 16th, west 40 miles. Davenport, Iowa, 16th, great damage to fences, trees and buildings, and navigation suspended. Topeka, Kan., 15th. southwest 54 miles, much damage to property. Dodge City. Kan., 14th and 15th, north 56 miles. Grand Rapids, Mich., 16th, 17th, violent southwest gale. Escanaba, 16th, much damage to shipping and other property. Port Huron, 16th, severe wind-storm lasting thirty-six hours, much damage to shipping. Grand Haven, 16th, southwest 48 miles, worst day ever seen at this station. Detroit, 17th, heavy southwest wind nearly all day. Genoa, Neb., 15th, violent wind-storm from the north, severest for many years. DeSoto, Neb., 16th, heavy northwest gale. North Platte, 16th, violent gale from northwest, 54 miles per hour. Wooster, Ohio, 17th, violent southwest wind nearly all day. Flemington, W. Va., 16th to 18th, very violent westerly winds. Ashland, Wis., 17th, heavy northeast gale, much damage to docks, warehouses and shipping. Bloomfield, Wis., 16th, violent southwest gale, much damage to fences and buildings. Milwaukee, 16th, southwest 60 miles, much dam-

age to buildings and telegraphic communication interrupted. Madison, Wis., 16th, west 44 miles, much damage to property. Breckenridge, northwest 56 miles, 1:30 p. m. Duluth, 16th, northeast and northwest 30 miles, very heavy sea on lake and much damage to shipping and wharfs. St. Vincent, Minn., 16th, violent storm from the north, highest velocity 40 miles per hour. St. Paul, violent gale ffom north-northwest, considerable damage in country and city, all telegraphic communication interrupted. Yankton, Dak., 16th, 70 miles northeast at 1 a. m.; roads blocked with snow and communication of all kinds suspended. Snow-drifts east of station reported to be from 10 to 15 feet high. Reports from different points estimate loss of cattle and crops in Yankton county at $5,000. Ft. Bennet, Dak., 16th, north 40 miles. Memphis, Tenn., 15th, 32 miles west, much damage to buildings in city. Little Rock, Ark., 15th, west 32 miles, considerable damage to bridges, fences and buildings.

Sand-storms.—Umatilla, Or., 13th; Winnemucca, Nev., 7th, 8th, 14th, 28th; Fort Yuma, Cal., 8th, 15th; Fort Garland, Col., 22nd.

VERIFICATIONS.

Indications.—The detailed comparison of the tri-daily indications for October, with the telegraphic reports for the succeeding twenty-four hours, shows the general percentage of verifications to be 88.9 per cent. The percentages for the four elements are: Weather, 90.2; Direction of the Wind, 87.3; Temperature, 90.2; Barometer, 87.8 per cent. By geographical districts they are: for New England, 89.3; Middle States, 90.1; South Atlantic States, 90.4; Eastern Gulf States, 87.4; Western Gulf States, 87.3; Lower Lake region, 89.9; Upper Lake region, 87.0; Tennessee and the Ohio valley, 89.4; Upper Mississippi valley, 88.6; Lower Missouri valley, 88.7; Northern Pacific coast region, 84.1; Central Pacific coast region, 99.1; Southern Pacific coast region, 94.6. There were 43 omissions to predict out of 3,813, or 1.13 per cent. Of the 3,770 predictions that have been made, 103, or 2.73 per cent. are considered to have entirely failed; 97, or 2.57 per cent. were one-fourth verified; 318, or 8.44 per cent. were one-half verified; 335, or 8.89 per cent. were three-fourths verified; 2,917, or 77.37 per cent., were fully verified, so far as can be ascertained from the tri-daily reports.

Cautionary Signals—242 Cautionary Signals were displayed during the month, of which 191, or 78.9 per cent., were justified by winds of 25 miles per hour or over at, or within a radius of 100 miles of, the station. 87 Off-shore Signals were displayed, of which 78 or 89.7 per cent, were fully justified, and 85 or 97.7 per cent, justified as to direction. Sixty-three of the Off-Shore were changed from Cautionary. 329 Signals of both kinds were displayed, of which 269 or 81.8 per cent, were fully justified. 47 cases of winds of 25 miles and over per hour, from scattered stations, were reported, for which signals had not been ordered. The above does not include signals ordered for 49 display stations, where the velocity is only estimated. Two signals were ordered late.

NAVIGATION.

In the table on the right-hand side of chart No. III are given the highest and lowest stages of water, as recorded on the Signal Service river gauges, during October, 1880. The rivers have in general been lower than during the past month and higher than during October of 1879. The *Mississippi* above the mouth of the Missouri fell steadily throughout the month, with the exception of a slight rise at St Paul, from the 15th to the 18th, and at Keokuk, where a temporary rise of 10 inches took place on the 17th, followed on the 18th by a fall of 12 inches. On the 9th, navigation above St. Paul was suspended. From St. Louis to Cairo there was generally a rise to the 8th, then a fall to the 18th, which, with slight exceptions, continued to the end of the month. At Memphis a constant rise to the 12th, then a steady fall to the 19th, afterwards fluctuating slightly to the end of the month. At New Orleans there was an alternate rise and fall every three or four days, the range for the month being but one foot. Excepting a rise at Omaha on the 25th of 14 inches, and at Leavenworth from the 14th to the 19th, the *Missouri* fell throughout the month. The *Tennessee* at Chattanooga fell steadily to the 16th, then rose slightly to the 19th, after which its tendency was downward. The *Ohio* remained at a low stage of water during the month; at Pittsburg there was a steady fall to the 25th, interrupted by a rise of 3 inches on the 17th, from the 21st to the end of the month there was a gradual rise; at Cincinnati, gradual rise to 9th, fall to the 29th, with slight exceptions. The *Cumberland* at Nashville remained almost stationary to the 14th, rising to the 17th, stationary to the 23rd, falling to the 26th, then rapidly rising to the end of the month. The *Red River* at Shreveport fluctuated alternately between 7 feet, 3 inches, its highest point and 4 feet, 6 inches, its lowest. The *Arkansas* at Little Rock fell gradually to the 25th, excepting a slight rise from the 15th to the 18th; from the 26th to the 31st the rise was gradual. The *Savannah* at Augusta fell and rose alternately throughout the month; on the 8th, during a violent northeast gale, it overflowed its banks injuring the rice crop. The *Penobscot* at Bangor, on the 6th, was so low as to cause the stoppage of mills; on the 20th it reached the lowest point in many years.

TEMPERATURE OF WATER.

The temperature of water, as observed in rivers and harbors at Signal Service Stations, with the average depth at which observations were taken, is given in the table on the left hand side of chart No. II. Owing to the breaking of the thermometer, no observations were made at Burlington, Vt., from the 17th to the 25th inclusive.

ATMOSPHERIC ELECTRICITY.

Thunder Storms.—Comparatively few have been reported during the month and mostly from the northern sections of the country. The most extensive, as well as severe, was that of the 15th and 16th. Distributed among the several States, they were reported on the following dates:—*Maine:* 23rd. *Massachusetts:* 12th, 23rd, 25th, 30th and 31st. *New York:* 3rd, 12th and 16th. *Virginia:* 15th, 22nd and 30th. *North Carolina:* 22nd. *Florida:* 3rd, 5th, 7th and 28th. *Tennessee:* 3rd, 14th, 15th, 16th and 26th. *Kentucky:* 14th and 15th. *Ohio:* 1st, 2nd, 14th, 15th, 17th and 21st. *Indiana:* 1st and 15th. *Illinois:* 1st, 2nd, 3rd, 14th, 15th, 21st, 24th and 25th. *Michigan:* 1st, 2nd, 3rd, 4th, 15th and 25th. *Wisconsin:* 10th and 16th. *Iowa:* 1st, 2nd, 3rd, 10th, 11th, 13th, 15th and 24th. *Missouri:* 15th and 25th. *Mississippi:* 27th. *Louisinna:* 3rd, 27th and 28th. *Texas:* 2nd, 3rd, 13th, 15th, 16th, 21st, 26th and 27th. *Indian Territory:* 13th, 15th and 25th. *Kansas:* 2nd and 20th. *Nebraska:* 2nd, 3rd and 13th. *Colorado:* 26th. *New Mexico:* 24th.

Auroras.—The most extensive occurred on the evenings of the 7th, 28th and 30th, and the early morning of the 31st, and were reported by various observers, both Signal Service and Voluntary, from stations reaching eastward from Dakota to Maine, and southward to the 37th parallel. That of the 30th, although very probably present in the Lower Lake region, Tennessee and the Ohio valley, was not visible on account of cloudy and threatening weather. The most frequent and profuse displays were observed in the New England States, followed next in order by Michigan and Minnesota. A detailed description from stations arranged by States will give data of additional interest, as follows: *Maine* Portland, 28th, 1:15 to 1:45 a. m., no motion; 31st, 11:15 to 11:40 p. m. Eastport, 7th, 9 p. m. Bangor, 29th, 1:00 to 3:00 a. m. Cornish, 7th, 25th, 28th, faint. Gardiner, 6th, 8th, 25th, 27th, 31st, faint. Orono, 1st. *New Hampshire:* Mt. Washington, 7th, 11 p. m., till morning; 25th, 9 p. m., till morning; 27th, 9 p. m., till morning. Grafton, 25th, 8:00 to 11:00 p. m., parallel and horizontal b nds of dark blue and white. *Vermont:* Burlington, 1st, midnight to 12:30 a. m.; 4th, 9:00 p. m., to 12:15 a. m.; 7th, 10:00 p. m., to 12:15 a. m.; 25th, 6:40 to 8:30 p. m.; 11:15 p. m., to midnight. Windsor, 7th, 9:00 p. m. Newport, 7th, 25th, 28th. Woodstock, 31st, early morning. *Massachusetts:* Wood's Holl, 31st, 11:00 p. m. Springfield, 31st, 11:18 to 11:35 p. m. Cambridge, 7th, 9:00 to 12:00 p. m.; 12th, 10:30 p. m.; 23rd, 7:30 to 9:00 p. m.; 25th, 9:00 to 11:30 p. m. Fall River, 7th, 9:00 p. m., faint; 24th, 9:00 to 11 p. m.; 25th, vertical at 9:00 p. m.; scintillations very bright; streamers from the southwest; a very unusual occurrence here. Newburyport, 7th, 25th, 31st, all very faint, no streamers and variable till midnight. Rowe, 7th, 11:00 p. m. Somerset, 23d, 28th, diffuse yellow light. *Connecticut:* Southington, 23d, 9:00 p. m.; 25th; 31st, 11:00 p. m. New London, 25th, 9:10 to 10:20 p. m. *Rhode Island:* Newport, 7th, 11:00 to 11:30 p. m.; 23d, 8 to 9:30 p. m. *New York:* Ardenia, 14th, 9:00 p. m. Argyle, 7th, 7 to 9 p. m., diffuse; 25th, 7 to 9 p. m. Rochester, 8:55 to 10:45 p. m. *Virginia:* Wytheville, 31st, tinged with red. *Michigan* Lansing, 31st, 1:30 a. m. Litchfield, 1st, 6th, 9th, 22d, all visible at 9:00 p. m. Port Huron, 28th, 1:10 to 2:20 a. m., color pale green, with faint streamers. *Wisconsin:* Manitowoc, 7th, 8:30 to 10:00 p. m., streamers. Ripon, 7th, 9:00 p. m., faint above a dark cloud. Milwaukee, 31st, 1 a. m., merry dancers. *Illinois:* Springfield, 9th, 10:00 p. m. Sterling, 31st, early morning. *Iowa:* Cresco, 31st, early morning, very faint. Ft. Madison, 30th, faint. Monticello, 30th, 11 p. m. Independence, 7th. *Minnesota:* St. Vincent, 1st, 8 p. m.; 7th; 9th, 4 a. m.; 23d, 9 p. m. St. Paul, 30th, 9 to 11 p. m. *Dakota:* Bismarck, 30th, 9 p. m. to midnight. Yankton, 31st, 2 a. m., faint arch. *Nebraska:* Clear Creek, 28th, p. m., faint.

Atmospheric Electricity Interfering with Telegraph Lines:—Umatilla, Or., 13th and 25th. El Paso, Tex., 23rd. Socorro, N. M., 2nd, 11th, 12th and 24th. Pilot Point, Tex., 2nd, 21st and 26th. Decatur, Tex., 26th. Jacksboro, Tex., 2nd and 21st. San Antonio, Tex., 27th. Fort Davis, Tex., 2nd. Stockton, Tex., 14th.

Zodiacal Light.—St. Vincent, Minn., 1st. Nashville, Tenn., 2nd, 6th to 14th and 31st. Fall River, Mass., 2nd and 3rd. Somerset, Mass, 1st and 2nd.

MISCELLANEOUS PHENOMENA.

Butterflies.—San Antonio, Tex., 16th, 17th. Melissa, Tex., 21st.

Grasshoppers.—Coleman City, Tex., 28th, flying south in great numbers.

Meteors.—Sterling, Ill., 31st. Woodstock, Md., 5th, 21st. Williamstown, Mass., 21st, 28th. Atco, N. J., 3rd, 25th. Penn Yan, N. Y., 5th. Bethel, Ohio, 13th; Wytheville, Va., 2nd.

Prairie and Forest Fires.—St. Vincent, Minn., 7th, 23rd, 24th. LaCrosse, 27th, 30th, 31st. Breckenridge, 1st, 2nd, 4th to 12th, 26th, 31st. Freehold, N. J., 13th. Wytheville, Va., 21st, 23rd to 26th, 29th.

Botanical.—Flushing, N. Y., 31st, wild flowers blooming. Elsworth, N. C., 21st, peach trees in bloom second time. Melissa, Tex., 22nd, roses in full bloom; potatoe vines still growing; 31st, cotton still blooming.

Polar Bands.—Portland, Or., 9th, 12th. Cleveland, 7th. Morgantown, 17th. New Haven, 17th.

Sterling, Ill., 31st. Gardiner, Me., 1st, 20th. Freehold, N. J., 16th, 17th, 26th. Cleb urne, Tex., 1st to 8th. Woodstock, Vt., 22nd. Wytheville, Va., 4th, 19th, 20th, 21st, 31st.

Sunsets.—The characteristics of the sky at sunset as indicative of fair or foul weather for the succeeding twenty-four hours have been observed at all Signal Service Stations. Reports from 134 stations show 4,116 observations to have been made, of which 19 were reported doubtful; of the remainder, 3,472 or 84.4 per cent. were followed by the expected weather.

Sea-fog Wave.—The recurrence of this phenomenon at New Westminster, B. C., which has been referred to in previous REVIEWS, occurred in 1879 on September 21st. This year it arrived on October 22nd, and Mr. A. Peele, the observer, comments upon it as follows: "On the 22nd we had thick fog until 10:30 a. m., when a small blue patch of sky was seen in the west, and in 15 minutes not a sign of fog existed, except in the south and southwest, where a heavy bank of fog remained until 2 p. m., when it began to move inland rapidly and the *annual sea-fog wave* again struck us, sending down the thermometer as it advanced." On October 26th he writes: "This year, so far, it has changed the whole character of the weather. We had a dry October, but since the wave came we have not had a fine day."

Sun Spots.—The following record of observations, made by Mr. D. P. Todd, Assistant, has been forwarded by Prof. S. Newcomb, U. S. Navy, Superintendent Nautical Almanac Office, Washington, D. C.:

DATE— Oct., 1880.	No. of new—		Disappeared by solar rotation.		Reappeared by solar rotation.		Total number visible.		REMARKS.
	Groups.	Spots.	Groups.	Spots.	Groups.	Spots.	Groups.	Spots.	
1st, 7 a. m....	1	5	0	10	0	0	4	55†	Faculæ.
3rd, 10 a. m....	1	5	0	10	0	0	4	60†	Faculæ.
4th, 4 p. m....	1	2	0	20	1	2	4	20†	Broad areas of faculæ.
6th, 8 a. m....	1	2	1	3	0	0	4	12	Faculæ.
7th, 9 a. m....	0	0	0	0	0	0	4	12	Faculæ.
8th, 8 a. m....	0	0	0	0	0	0	4	12	Faculæ.
9th, 9 a. m....	0	0	0	0	0	0	3	12	Faculæ.
1 p. m....	0	4	0	0	0	0	3	16	Faculæ.
5 p. m....	0	0	0	0	0	0	3	16	Faculæ.
10th, 3 p. m....	1	2	0	0	0	0	4	22	Faculæ.
11th, 10 a. m	1	2	0	0	0	0	5	24	Broad areas of faculæ; many of the spots small.
12th, 10 a. m....	0	0	1	4	0	0	4	14	Faculæ.
15th, 2 p. m....	0	0	1	2	0	0	3	12	
16th, 10 a. m....	0	0	0	2	0	0	3	10	
19th, 1 p. m....	2	10	.....	.....	1	3	3	25†	
21st, 8 a. m....	0	0	0	0	0	0	3	25†	Faculæ.
24th, 12 m....	2	13	.....	.....	.....	.....	3	25†	Faculæ.
2 p. m....	0	0	0	0	0	0	3	25†	Faculæ.
27th, 12 m ..	1	5	1	10	0	0	3	20†	Faculæ.

†Approximated.

Mr. William Dawson, at Spiceland, Ind., reports: 1st, 4 groups, 108 spots; 2nd, 4 groups, 75 spots, new group at E. edge; 5th, 5 groups, 8 spots, new group E. edge; 6th, 4 groups, 20 spots, faculae at W. edge; 7th, 4 groups, 16 spots, faculæ at E. edge; 8th, 3 groups, 16 spots; 9th, 3 groups, 33 spots; 12th, 3 groups, 10 spots, new group and much faculae at E. edge; 13th, 3 groups, 13 spots; 20th, 4 groups, 50 spots; 21st, 3 groups, 55 spots; 29th, 4 groups, 18 spots; 31st, 3 groups, 12 spots.

Mr. David Trowbridge, Waterbury, N. Y., reports: 1st, same groups as on September 30th, 11 spots; 2nd, same groups, 4 spots; 3rd, 2 groups in W., 5 spots, faint group in E.; 4th, same; 5th, 2 groups, 2 spots; 6th, same; 7th, E. group, 1 spot, and new group in the NE. quadrant; 8th, 1 spot in the W. group and 3 in the NE. group; 9th, same groups still visible, with 5 spots; 10th and 11th, same groups, with 7 spots; 12th, groups of yesterday have disappeared by solar rotation, new spot near E. limit; 13th, 1 spot visible in the NE. quadrant; 14th, same still visible and a new group appearing by rotation in the NE. quadrant; 15th and 18th, same, 2 spots; 20th, 3 groups, 8 spots; the two old groups have changed so that the W. group has 4 spots and the E. group 2; new group, 2 spots in SE. quadrant; 21st, same; 25th, 2 groups, the new one in the NE. quadrant having 3 spots; 28th, 2 groups; 31st, 1 group of faint spots in SE. quadrant; 16th, 17th, 19th, 22nd, 23rd, 24th, 26th, 27th, 29th and 30th, cloudy.

Mr. H. D. Gowey, at North Lewisburg, O., reports that he observed spots every day during the month, but gives particulars of the largest spots only, as follows: October 1st, 6:05 a. m. (Washington mean time) 2 groups, the one containing one large and five smaller spots in the NE. quadrant, the other containing one large and seven smaller spots in NW. quadrant; 5th, 12:05 p. m., two large spots, one in the NE. quadrant near edge and the other in the centre of the SW. quadrant; 10th, 7:20 a. m., 2 groups, one of three spots in the NE. quadrant, the other of five spots in the SW. quadrant; 16th, 12:50 p. m. two spots in the W. just N. of equator, one quite large the other much smaller; 21st, 1:20 p. m., 3 groups, one of two large and three small spots in the NE. quadrant, the second of three large spots north of the centre and the third of one large and three small spots in the SW. quadrant; 31st, 7:35 a. m., 2 groups of two spots each, one in the NW. quadrant the other in the SE. quadrant; large spots were more numerous on the 21st than on any other day.

NOTES AND EXTRACTS.

Extract from the American Journal of Science, No. 116, Vol. XX. August, 1880.

Aqueous Vapor in Relation to Perpetual Snow; by James Croll, LL.D., F. R. S.—Some twelve year ago I gave (Phil. Mag., March, 1867, Climate and Time, p. 548) what appears to be the true explanation of that apparently paradoxical fact observed by Mr. Glaisher that the difference of reading, between a thermometer exposed to direct sunshine and one shaded, *diminishes* instead of increases, as we ascend in the atmosphere. This led me to an important conclusion in regard to the influence of aqueous vapor on the melting of snow, but recent objections to some of my views convince me that I have not given to that conclusion the prominence it deserves. I shall now state in a few words the conclusion to which I refer.

The reason why snow at great elevations does not melt but remains permanent, is owing to the fact that the heat received from the sun is thrown off into stellar space so rapidly by radiation and reflection that the sun fails to raise the temperature of the snow to the melting point; the snow evaporates but does not melt. The summits of the Himalayas, for example, must receive more than ten times the amount of heat necessary to melt all the snow that falls on them, notwithstanding which the snow is not melted. And in spite of the strength of the sun and the dryness of the air at these altitudes, evaporation is insufficient to remove the snow. At low elevations, where the snow-fall is probably greater, and the amount of heat received even less than at the summits the snow melts and disappears. This, I believe, we must attribute to the influence of aqueous vapor. At high elevations the air is dry and allows the heat radiated from the snow to pass into space, but at low elevations a very considerable amount of heat radiated from the snow is absorbed by the aqueous vapor which it encounters in passing through the atmosphere. A considerable portion of the heat thus radiated being of the same quality as that which the snow itself radiates, is on this account absorbed by the snow. Little or none of it is reflected like that received from the sun. The consequence is that the heat thus absorbed accumulates in the snow till melting takes place. Were the amount of aqueous vapor possessed by the atmosphere sufficiently diminished, perpetual snow would cover our globe down to the sea-shore. It is true that the air is warmer at the lower level than at the higher level and by contact with the snow must tend to melt it more at the former than at the latter position. But we must remember that the air is warmer mainly in consequence of the influence of aqueous vapor, and that were the quantity of vapor reduced to the amount in question, the difference of temperature at the two positions would not be great.

But it may be urged as a furthur objection to the foregoing conclusion, that as a matter of fact on great mountain-chains, the line reaches to a lower level on the side where the air is moist than on the opposite side where it is dry and arid. As, for example, on the southern side of the Himalayas and on the eastern side of the Andes where the snow-line descends some 2,000 or 3,000 feet below that of the opposite, or dry side. But this is owing to the fact that it is on the moist side that by far the greatest amount of snow is precipitated. The moist winds of the SW. monsoon deposit their snow almost wholly on the southern side of the Himalayas, and the SE. trades, the snow on the east side of the Andes. Were the conditions in every respect the same on both sides of the mountain ranges with the exception only that the air on one was perfectly dry, allowing radiation from the snow to pass without interruption into stellar space, while on the other side the air was moist and full of aqueous vapor, absorbing the heat radiated from the snow, the snow-line would, in this case, undoubtedly descend to a lower level on the dry than on the moist side. No doubt more snow would be evaporated off the dry than off the moist side, but melting would certainly take place at a greater elevation on the moist than on the dry side, and this is what would mainly determine the position of the snow-line. * * * * * *

PUBLISHED BY ORDER OF THE SECRETARY OF WAR.

Adjutant General, and
Acting Chief Signal Officer of the Army.

Copy furnished for

Entered at the Post Office at Washington, D. C., as Second-Class matter.

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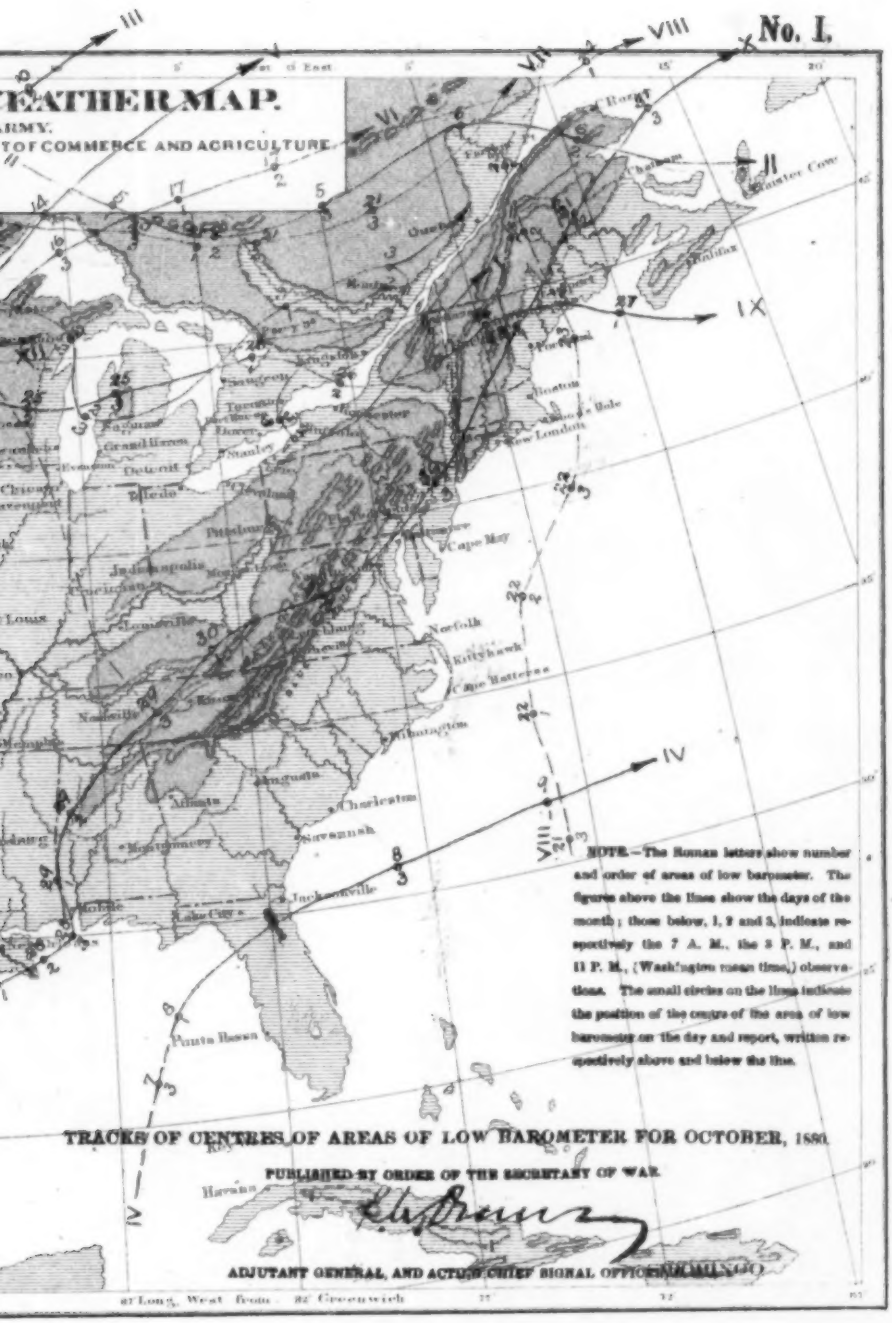
WAR DEPARTMENT WE
SIGNAL SERVICE, U.S. ARMY
DIVISION OF TELEGRAMS AND REPORTS FOR THE BENEFIT OF
AVERAGE PROGRESS OF AREAS OF LOW BAROMETER
No. | Velocity.
I. 28 miles per hour.
II. 22 do.
III. 8 do.
IV. 22 do.
V. 31 do.
VI. 31 do.
VII. 28 do.
VIII. 31 do.
IX. 28 do.
X. 19 do.
XI. 17 do.
XII. 20 do.

No. I.



NOTE.—The Roman letters show number and order of areas of low barometer. The figures above the lines show the days of the month; those below, 1, 2 and 3, indicate respectively the 7 A. M., the 3 P. M., and 11 P. M., (Washington mean time,) observations. The small circles on the lines indicate the position of the centre of the area of low barometer on the day and report, written respectively above and below the line.

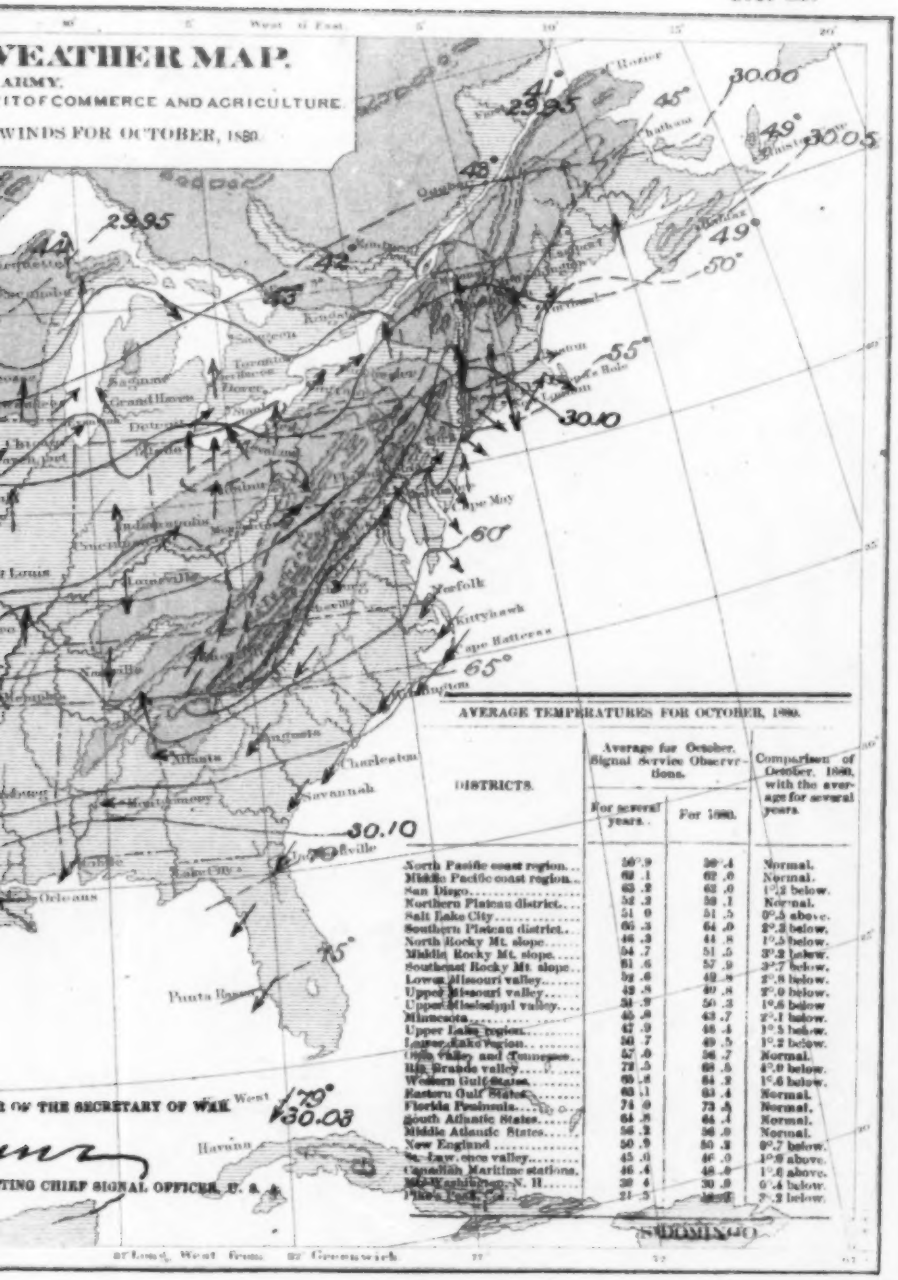
TRACKS OF CENTRES OF AREAS OF LOW BAROMETER FOR OCTOBER, 1880.

PUBLISHED BY ORDER OF THE SECRETARY OF WAR.

ADJUTANT GENERAL, AND ACTING CHIEF SIGNAL OFFICER U.S.A.

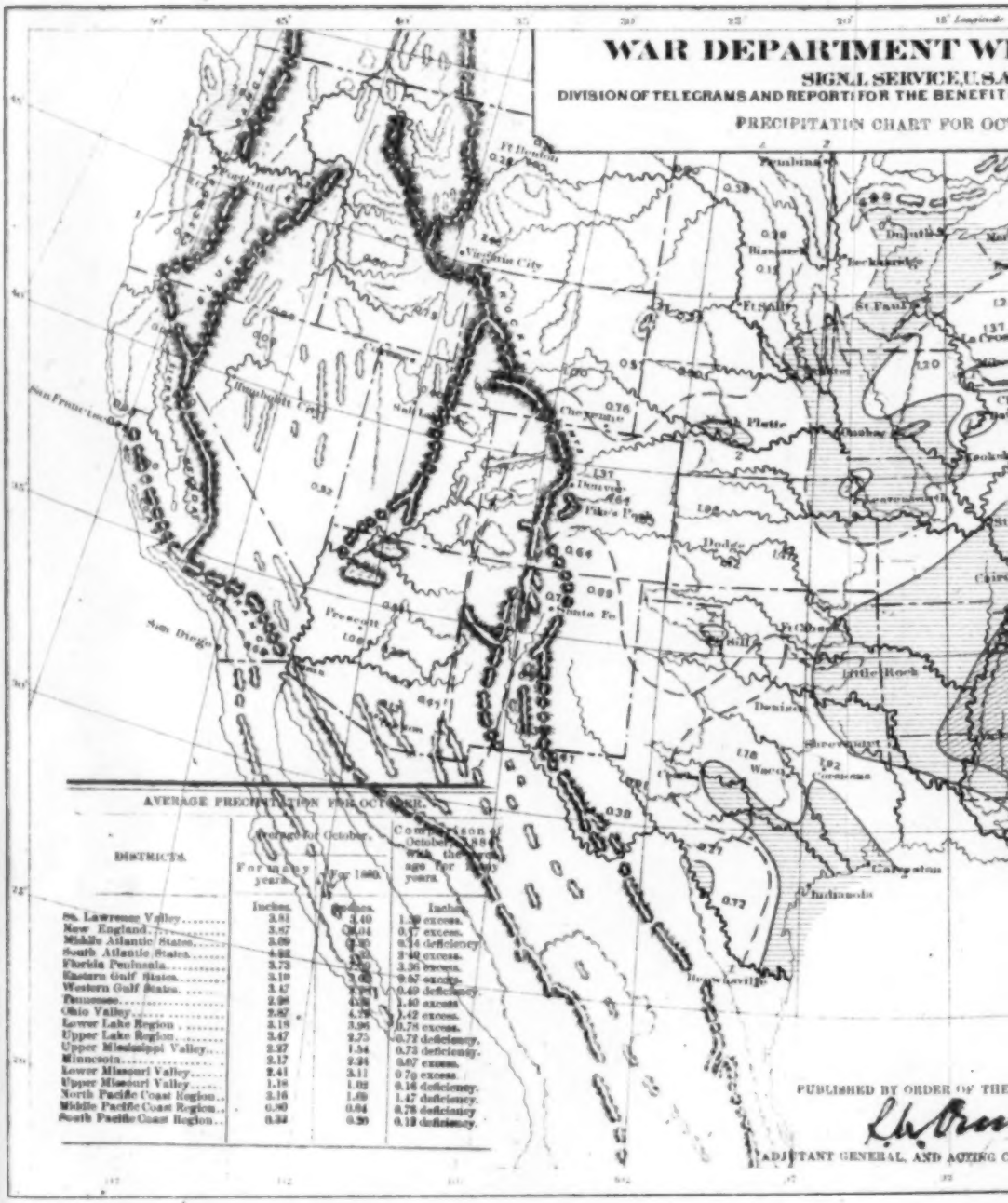
87 Long. West from 82 Greenwich

WAR DEPARTMENT WEAT
SIGNAL SERVICE, U.S. ARMY.
DIVISION OF TELEGRAMS AND REPORTS FOR THE BENEFIT OF COMM
ISOBARS, ISOTHERMS AND PREVAILING WINDS FO
30.10
30.17
30.10
30.04
30.05
30.00
29.95
30.05
TEMPERATURE OF WATER FOR
OCTOBER, 18
STATIONS.
Temperature at bottom
Max.
Min.
Alpena 59
Augusta 74
Baltimore 68
Buffalo 60
*Burlington, Vt 59
Cedar Keys 81
Charleston 78
Chicago 64
Chincoteague 77
Cleveland 63
Detroit 61
Duluth
Del. Breakwater 67
Eastport 59
Escanaba 56
Galveston 78.5
Grand Haven 59
Jacksonville 79
Key West 83
Marquette 68
Milwaukee 63.5
Mobile 78
New London 64
New York 66
Norfolk 73
Portland, Maine 58
Punta Rassa 83
Sandusky 59
San Francisco 60
Savannah 76
Smithville 74
Toledo 60
Wilmington 75
Wood's Holl 66
* Observations for only part of month—See text.
Galveston
Indianola
70
65
PUBLISHED BY ORDER OF THE
ADJUTANT GENERAL, AND ACTING CHI



AVERAGE TEMPERATURES FOR OCTOBER, 1880.

DISTRICTS.	Average for October, Signal Service Observations.		Comparison of October, 1880, with the average for several years.
	For several years.	For 1880.	
North Pacific coast region	50°.9	50°.4	Normal.
Middle Pacific coast region	62 .1	62 .0	Normal.
San Diego	63 .2	63 .0	1°.2 below.
Northern Plateau district	52 .2	52 .1	Normal.
Salt Lake City	51 .0	51 .5	0°.5 above.
Southern Plateau district	66 .3	64 .0	2°.3 below.
North Rocky Mt. slope	46 .3	44 .8	1°.5 below.
Middle Rocky Mt. slope	54 .7	51 .5	3°.2 below.
Southeast Rocky Mt. slope	61 .6	57 .9	3°.7 below.
Lower Missouri valley	52 .6	49 .8	2°.8 below.
Upper Missouri valley	43 .8	40 .8	3°.0 below.
Upper Mississippi valley	51 .7	50 .3	1°.6 below.
Minnesota	45 .8	43 .7	2°.1 below.
Upper Lake region	47 .0	46 .4	1°.5 below.
Lower Lake region	50 .7	49 .5	1°.2 below.
Ohio valley and Tennessee	57 .0	56 .7	Normal.
Big Brazos valley	73 .5	68 .5	4°.0 below.
Western Gulf States	69 .8	64 .2	1°.6 below.
Eastern Gulf States	63 .1	63 .4	Normal.
Florida Peninsula	74 .0	73 .5	Normal.
South Atlantic States	64 .8	64 .4	Normal.
Middle Atlantic States	56 .2	56 .0	Normal.
New England	50 .9	50 .2	0°.7 below.
St. Lawrence valley	45 .0	46 .0	1°.0 above.
Canadian Maritime stations	46 .4	48 .0	1°.6 above.
Mt. Washington, N. H.	30 .6	30 .0	0°.6 below.
Pikes Peak	21 .5	18 .3	3°.2 below.



AVERAGE PRECIPITATION FOR OCTOBER.

DISTRICTS.	Average for October. For many years.	For 1880.	Comparison of October, 1880, with the average for many years.
	Inches.	Inches.	Inches.
St. Lawrence Valley	3.81	5.40	1.59 excess.
New England	3.87	4.04	0.17 excess.
Middle Atlantic States	3.09	2.35	0.74 deficiency
South Atlantic States	4.82	8.22	3.40 excess.
Florida Peninsula	3.73	7.09	3.36 excess.
Eastern Gulf States	3.10	4.07	0.97 excess.
Western Gulf States	3.47	2.98	0.49 deficiency.
Tennessee	2.98	4.38	1.40 excess.
Ohio Valley	2.87	4.29	1.42 excess.
Lower Lake Region	3.19	3.96	0.78 excess.
Upper Lake Region	3.47	2.75	0.72 deficiency.
Upper Mississippi Valley	2.27	1.54	0.73 deficiency.
Minnesota	2.12	2.99	0.87 excess.
Lower Missouri Valley	2.41	3.11	0.70 excess.
Upper Missouri Valley	1.18	1.02	0.16 deficiency.
North Pacific Coast Region	3.16	1.69	1.47 deficiency.
Middle Pacific Coast Region	0.90	0.04	0.78 deficiency
South Pacific Coast Region	0.34	0.20	0.13 deficiency.

No. 111.

NT WEATHER MAP.

ICE, U.S. ARMY.

E BENEFIT OF COMMERCE AND AGRICULTURE.

T FOR OCTOBER, 1880.

ER OF THE SECRETARY OF WAR

D ACTING CHIEF SIGNAL OFFICER, U. S. A.

RIVERS ABOVE LOW-WATER MARK, OCT., 1880.

STATIONS.	Danger point on gauge.	HIGHEST WATER. Date.	HIGHEST WATER. Height.	LOWEST WATER. Date.	LOWEST WATER. Height.
	ft. in.	Oct.	ft. in.	Oct.	ft. in.
RED RIVER.					
Shreveport	29 0	7	7 3	29	4 8
ARKANSAS.					
Little Rock	—	19 to 30	1 8	13 to 14	†2 8
MISSOURI.					
Yankton	20 0	—	—	—	—
Omaha	16 0	1	6 9	31	5 8
Leavenworth	21 0	1 to 3	6 6	31	0 2
MISSISSIPPI.					
St. Paul	14 0	27	2 8	10 to 14	1 8
La Crosse	19 0	30, 31	1 10	15, 16	1 1
Dubuque	21 10	1	3 11	15, 16	2 0
Davenport	15 0	1	4 1	15	2 1
Keokuk	14 6	1	7 4	19	3 1
St. Louis	30 0	4	13 6	31	0 5
Cairo	40 0	7, 8	9 5	30	6 1
Memphis	34 6	7 to 11	7 2	21 to 27	2 9
Vicksburg	41 0	1	5 11	25	7 8
New Orleans	— 2 6	24	12 8	1	— 3 8
OHIO.					
Pittsburgh	20 0	31	3 4	29	†0 6
Cincinnati	50 0	2	6 4	28, 29	2 2
Louisville	24 0	11 to 14	4 5	2, 3; 29 to 31	3 0
CUMBERLAND.					
Nashville	42 0	31	9 11	1, 9, 10	0 11
TENNESSEE.					
Chattanooga	31 0	1	3 5	16 to 20	1 0
MONONGAHELA.					
Morgantown	28 0	31	10 9	20, 21	4 6
Pittsburgh	30 0	31	3 4	20	†0 6
SAVANNAH.					
Augusta	—	1	5 2	27, 28	1 2
WILLAMETTE.					
Portland, OR	—	—	—	—	—

*Below high water mark of 1874. †Below gauge.

NOTICE

CHART No. IV.

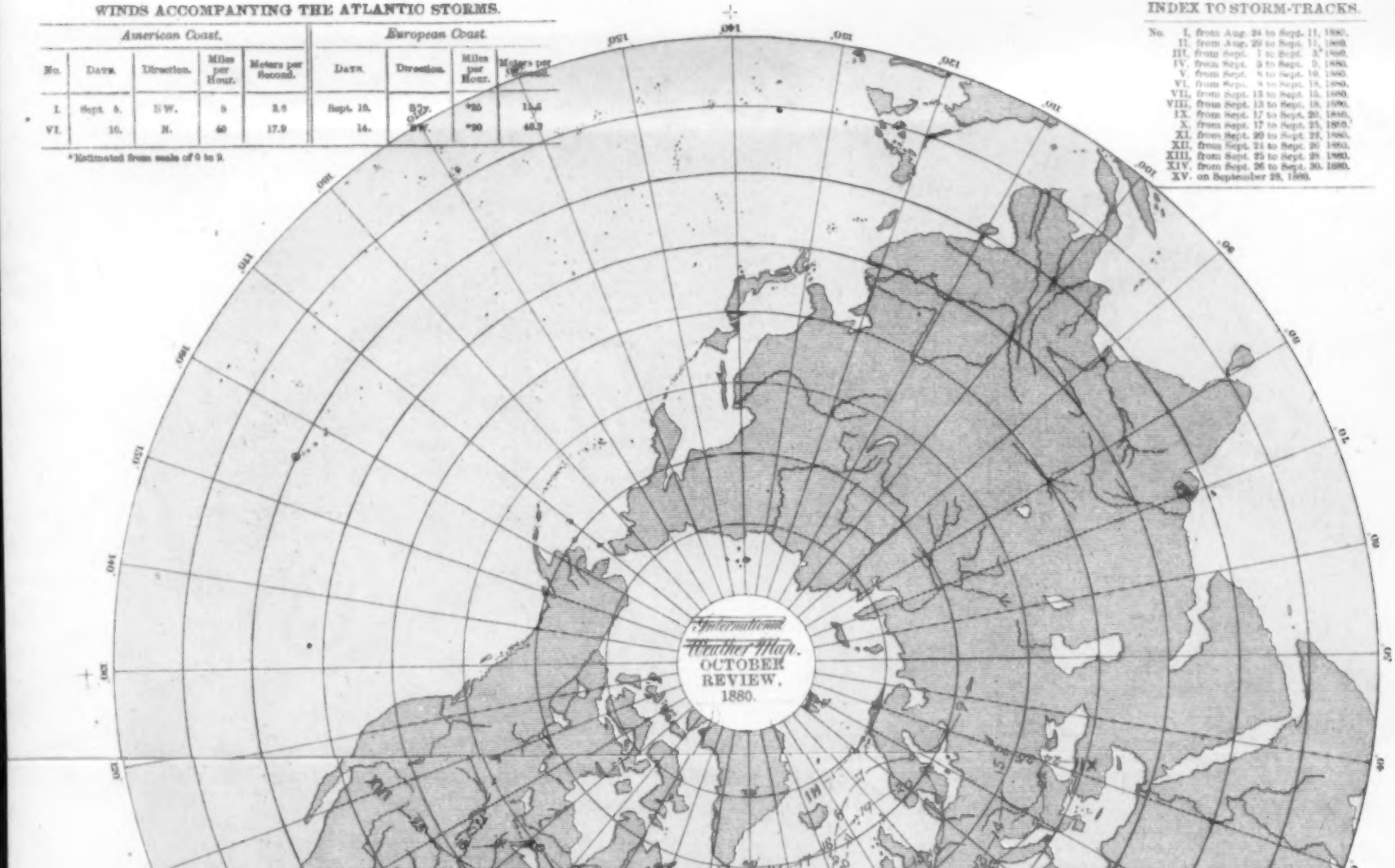
WINDS ACCOMPANYING THE ATLANTIC STORMS.

	American Coast.				*European Coast.*			
No.	Date.	Direction.	Miles per Hour.	Meters per Second.	Date.	Direction.	Miles per Hour.	Meters per Second.
I.	Sept. 5.	NW.	5	2.6	Sept. 10.	SSW.	*25	11.6
VI.	16.	N.	40	17.9	14.	SW.	*20	40.2

*Estimated from scale of 0 to 9.

INDEX TO STORM-TRACKS.

No. I, from Aug. 24 to Sept. 11, 1880.
II. from Aug. 29 to Sept. 11, 1880.
III. from Sept. 1 to Sept. 25, 1880.
IV. from Sept. 3 to Sept. 9, 1880.
V. from Sept. 8 to Sept. 16, 1880.
VI. from Sept. 8 to Sept. 18, 1880.
VII. from Sept. 13 to Sept. 15, 1880.
VIII. from Sept. 13 to Sept. 18, 1880.
IX. from Sept. 17 to Sept. 20, 1880.
X. from Sept. 17 to Sept. 25, 1880.
XI. from Sept. 20 to Sept. 28, 1880.
XII. from Sept. 24 to Sept. 30, 1880.
XIII. from Sept. 25 to Sept. 28, 1880.
XIV. from Sept. 26 to Sept. 30, 1880.
XV. on September 28, 1880.



INTERNATIONAL METEOROLOGY—OCEAN STORM-TRACKS.

Broken or dotted lines indicate that the lines so broken are doubtful.

Arrows, when charted, fly with the wind and exhibit wind-direction.

The tracks charted in black have appeared in previous *Reviews*.

The tracks charted in red have been made from data collected since preceding *Review*.

PUBLISHED BY ORDER OF THE SECRETARY OF WAR.

BRIG. GEN. (BVT. ASSG'D) CHIEF SIGNAL OFFICER U. S. A.

Office of the Chief Signal Officer,

UNITED STATES ARMY.

No. V.

Charted from Actual Observations taken Simultaneously. Series commencing September, 1877.

PREVAILING WINDS.

Arrows show the direction *of*, and fly with, the wind
Force is shown as follows:

SYMBOLS.	FORCE.	VELOCITY.	
		Miles per hour.	Metres per second.
→	1, 2	0 to 9	0 to 4.0
→	3, 4	9.1 to 22.5	4.1 to 10.1
→	5, 6	22.6 to 40.5	10.1 to 18.1
→	7, 8	40.6 to 67.5	18.1 to 30.2
→	9, 10	67.6 up.	30.2 & over.

PUBLISHED BY ORDER OF THE SECRETARY OF WAR.

Adjt. Gen. and Chief Signal Officer

BRIG. GEN. U. S. A. CHIEF SIGNAL OFFICER. U. S. A.

ISOBARS AND ISOTHERMS.

Isobars in *blue*; detached barometer means in English inches.

Isotherms in *red*; detached temperature means in degrees Fahrenheit.

Broken lines, are doubtful.

INTERNATIONAL MONTHLY CHART.

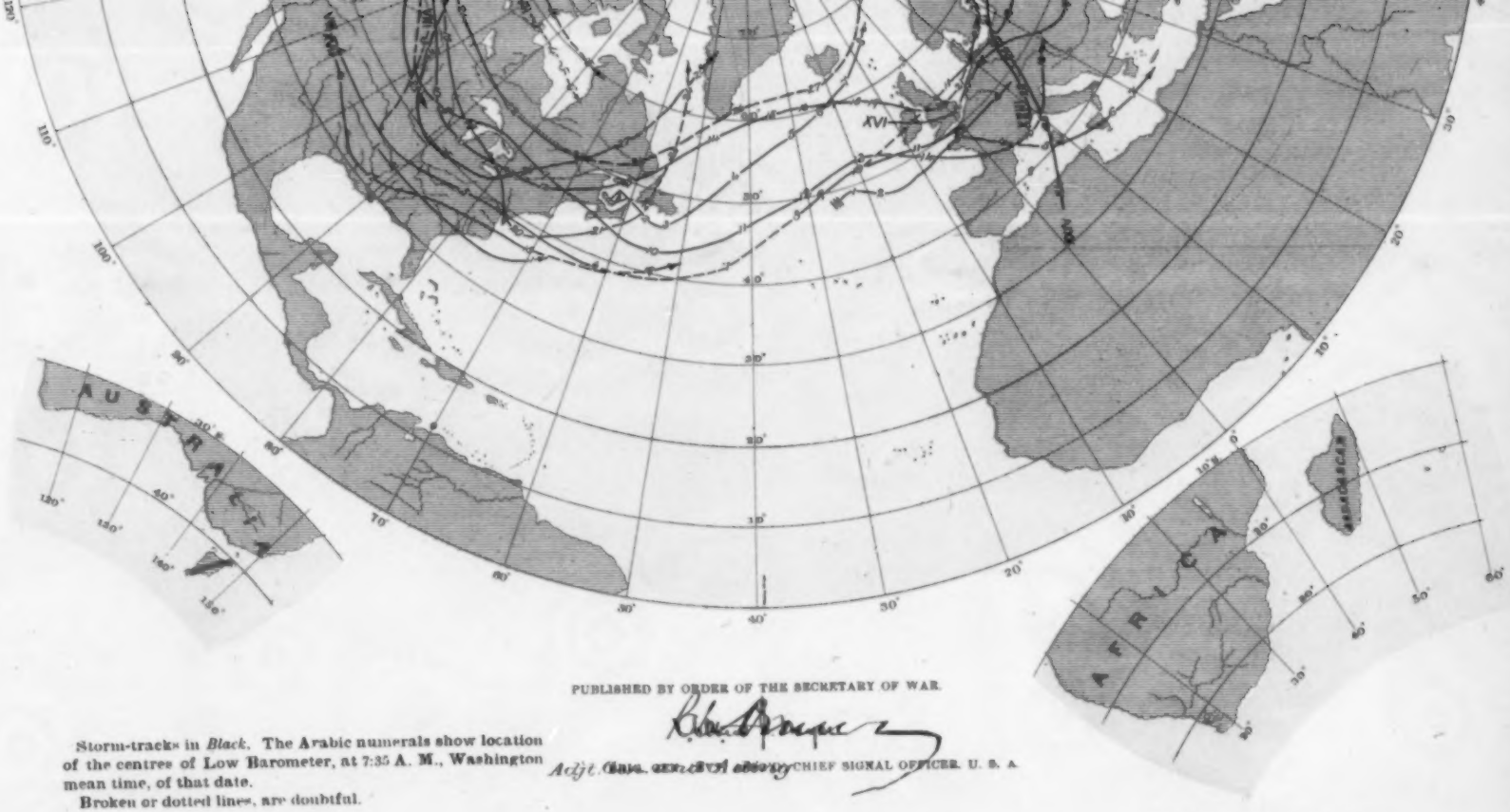
Showing mean pressure, mean temperature, mean force and prevailing direction of winds at 7:35 A. M., Washington mean time, for the month of February, 1879, based on the daily charts of the International Bulletin.

Office of the Chief Signal Officer,

UNITED STATES ARMY.

Charted from Actual Observations taken Simultaneously, Series commencing October, 1877.

No. VI.



PUBLISHED BY ORDER OF THE SECRETARY OF WAR.

Adjt. Gen. ... CHIEF SIGNAL OFFICER. U. S. A.

Storm-tracks in *Black*. The Arabic numerals show location of the centres of Low Barometer, at 7:35 A. M., Washington mean time, of that date.

Broken or dotted lines, are doubtful.

INTERNATIONAL CHART

Showing Tracks of Centres of Low Barometer for February, 1879.